INFINITY
SOFTWORKS

powerOne™ Graph
for the Palm® Operating System

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Table of Contents

Getting Started

This section helps you get started using your powerOne™ Graph graphing calculator.

Setting the Default Calculator

To set a powerOne product as the default calculator, enter the application and choose the powerOne button in the upper, left-hand corner of the main calculator display. From the list, select powerOne Prefs and check the "Use Calc Button" checkbox.

The Palm OS Device

This manual references certain objects of the Palm® OS device itself:

In addition, this manual will refer to scroll arrows, scroll buttons, and scroll bars. Scroll arrows appear in the lower, right-hand corner of the screen or in the pop-up list. Scroll bars appear next to the data to be scrolled. And scroll buttons are shown in the graphic above.

Number Ranges

powerOne Graph allows for entry of numbers up to 15 digits. Numbers larger than this will display in scientific notation (i.e., 1.234e13). In addition, powerOne Graph also allows for entry in scientific notation. Due to display restrictions, the worksheets cannot display numbers this large. In general, worksheets display 12 digits.

Canceling Calculations

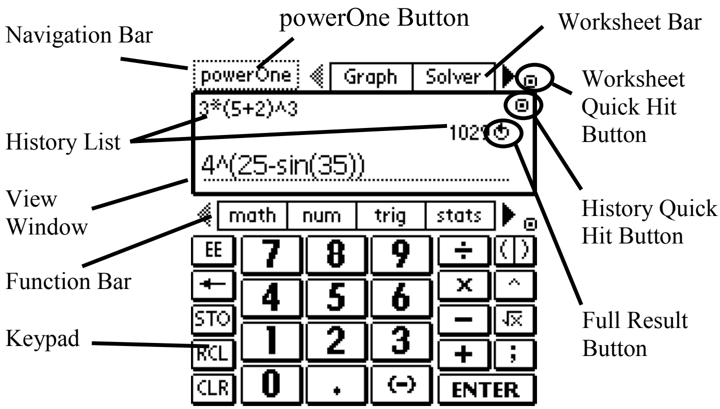
If the calculation will take more than a second, a dialog will appear. While this dialog is displayed, the calculation can be cancelled by tapping the “Cancel” button in the dialog (if there is no cancel button, tap on the dialog). Note that the displayed answer will be incorrect – instead it will be the last iterated answer while calculating. See the section on How the Solver Works for more information.

Time, Date and Number Formats

powerOne Graph uses the system settings for time, date and number formats. To change these, select the Home button and choose Prefs from the list of applications (if it is not showing, make sure “All” is showing in the pop-up list in the top, right-hand corner). Select “Formats” in the top, right-hand corner to change the preferences.

The powerOne™ Display

This section discusses the main calculator's display. The display is broken into five sections: the navigation bar across the top, the view window, the function bar, the keypad and the menu.



Each section is outlined below.

Navigation Bar

The **navigation bar** is used to move quickly to worksheets contained within the application, or gain access to information and settings. The **powerOne button**, on the left-hand side of the navigation bar, offers access to online help, product information, and application preferences. The **worksheet bar**, on the right-hand side of the navigation bar, offers quick access to worksheets within the application. Tapping the arrows left or right scrolls more worksheet categories into view while tapping the **worksheet quick-hit button** displays all available worksheet categories at one time.

View Window

The **view window** has four components: the **entry field**, the **full result button**, the **history list**, and the **history quick-hit button**. Some

worksheets also use the view window for entering functions (for instance, graphing uses the view window to enter equations). The entry field functions like a standard PalmOS® text field. To enter information, first make sure the cursor is blinking at the entry (or insertion) point, then tap a keypad button or enter Graffiti® characters. This field does scroll. If the field is more than one line, a scroll bar will appear for the currently selected entry field.

The history list displays the last entry in the entry field as well as the answer or error message associated with that entry. Tapping the history quick-hit button will display the last four entries and answer combinations in a pop-up window. Selecting an item from the history list or from the history pop-up window will insert the text into the entry line at the insertion point.

To see the full result of the item in the history list, select the full result button. If it is a value, the full precision of the item will be inserted in the entry line. If the item is a matrix or table, the display will switch to its view.

Function Bar

The **function bar** includes advanced mathematical functions for use within powerOne Graph. These functions are broken into eight sub-groups: **math**, **number** (num), **trigonometric** (trig), **statistics** (stats), **probability** (prob), **complex numbers** (cmplx), **matrices** (matrix), **calculus** (calc), **constants** (const), **boolean** (bool), **developer** (dev), and **memory** (mem). Tapping the arrows left or right scrolls into view more functions, while tapping the **function quick-hit button** displays all available functions at one time.

Keypad

The **keypad** is a series of buttons that allow for rapid entry of numbers and commonly used mathematical functions. The left side (top to bottom) consists of buttons to enter an exponent for exponential notation, backspace over a character or highlighted text, store to memory, recall from memory, and clear the current equation. In the

center, the number pad includes 0 through 9, the decimal separator (whether a decimal point or comma as dictated by the system Preferences setting. See your handheld manual), and a negative sign. On the right are the standard mathematical functions: divide, multiply, subtract, and add, commonly used functions to insert left and right parentheses, power (^), square root and the function separator (semi-colon). To evaluate a function (get the answer), select Enter.

Menus

Choosing the menu button to the lower, left-hand corner of the Graffiti input area accesses the menus. Standard PalmOS edit choices, Graffiti help, and powerOne Preferences and application information can be accessed from here.

The Edit menu:

Function	**Shortcut**	**Comments**
Undo	/U	Undo the last Graffiti entry
Cut	/X	Cut the selected text to the clipboard
Copy	/C	Copy the selected text to the clipboard
Paste	/P	Paste the text from the clipboard to the entry field (at the cursor position)
Select All	/S	Select the entire entry field
Keyboard	/K	Display the pop-up keyboard
Graffiti	/G	Help with Graffiti keystrokes

The Options menu:

Function	**Shortcut**	**Comments**
Preferences …	/R	Display the calculator preferences. Also reached from the powerOne button
Beam powerOne		Beam powerOne Graph to another user. Also reached from the powerOne button
About powerOne		Display company information. Also reached from the powerOne button

Performing Arithmetic

The main calculator of powerOne Graph serves as an algebraic calculator. Equations are entered in full in the entry field using either Graffiti characters or entries from the keypad and function lists. Once the entire equation is entered, selecting ENTER evaluates the equation and returns an answer.

Basic mathematical functions can be entered from the keypad, from the function bar or by using Graffiti to enter characters.

Entering Numbers (0-9; ./,; –; ←; CLR)

To enter a number, tap the corresponding keypad button (0-9, decimal point, or sign).

To enter -356.96, for instance, do the following:

Key	Display	Comments
CLR		Tap once clears the entry field
(–)	-	Negative sign
3	-3	
5	-35	
6	-356	
. or ,	-356.	Depends on the number format
9	-356.9	
6	-356.96	

The **decimal point** can either be displayed as a period or as a comma. This depends on the number format mode used. See your handheld device owner's manual for more details.

The following are number entry functions:

Operation	Example	Comments
Number	0-9	Number pad items
Decimal point	. or ,	Depends on the number format
Sign (–)	–	
Exponent (EE)	E	Exponential notation

To enter a number in **exponential notation** enter the mantissa then enter the exponent.

For example, to enter -1.29E-54 do the following:

Key	Display	Comments
CLR		Tap once to clear the entry field
(–)	-	
1.29	-1.29	
EE	-1.29E	
(–)	-1.29E-	
54	1.29E-54	

The **backspace** (←) button allows for editing of numbers as they are entered. Tapping this button removes the character before the cursor. If a series of characters is highlighted and then the backspace is selected, the entire highlighted section is removed.

Tapping the **clear** (CLR) button clears the contents of the currently selected entry field.

Basic Mathematics

powerOne Graph uses algebraic entry mode. In algebraic entry mode, an entire equation is entered and then it is evaluated. Basic math functions reside within the keypad along the right-hand side.

If we wanted to perform 27 + 3 x 8.5:

Key	Display	Comments
CLR		Tap once to clear the entry field
27	27	
+	27+	
3	27+3	
x	27+3*	
8.5	27+3*8.5	
Enter	52.5	

The number of decimal places displayed depends on the decimal display preference. See the section on Preferences for more information.

Notice that powerOne Graph multiplies before adding. This calculator follows the rules for order of operations. See the section on parentheses to change the order of operation, or see the Appendix for a list of these rules.

The following are basic math examples:

Operation	**Example**	**Keystroke**	**Answer**
Addition	8 + 3	8 [+] 3 [ENTER]	11
Subtraction	8 – 3	8 [–] 3 [ENTER]	5
Multiplication	8 x 3	8 [x] 3 [ENTER]	24
Division	8 ÷ 3	8 [÷] 3 [ENTER]	2.66…7
Power	3^4	3 [^] 4 [ENTER]	81
Square Root	√8	[√x] 8 [ENTER]	2.828…
Reciprocal	1/5	[1/x] 5 [ENTER]	0.2

Advanced Mathematics

powerOne Graph contains advanced math functions within the function bar (just below the view window). These functions are split into eight subgroups (from left to right when scrolling): general math functions (math), number (num), trigonometric (trig), statistics (stats), constants (const), boolean (bool), developer (dev), and memory (mem).

Advanced math functions can be defined in two ways: as a call or as a symbol. For instance, percent ("%") is a symbol. Entering "34%" in the entry field and tapping Enter returns 0.34 as the answer. On the other hand, Natural Logarithm is a call. In this case, "ln(15)" would be entered in the entry field to return the natural log of 15. The answer is 2.708. Another call example is round (rounds a number to a set number of decimal places). Round can accept two function arguments: a value to round and the number of decimal places to

round to. In this case, use a semi-colon to separate the variables. Entering "round(2.738058; 2)" will return 2.74.

Each of these functions is defined in the Function List.

Constants

powerOne Graph offers a series of constants built-in to the calculator. These can be accessed via the "const" function bar category:

Function	**Display**	**Comments**
PI (∏)	pi	pi = 3.14159265359
Exponential	e	e = 2.71828182846
Avogadro's Number	NA	NA = 6.02214199E23/mol
Coulomb	k	k = 8,987,551,787.37
Elem. Charge	ec	ec = 1.60217646E-19 C
Univ. Gas Constant	R	R = 8.314472 J/mol K
Gravity Constant	G	G = 6.67259E-11 $m^3/kg\ s^2$
Gravity Acc	g	g = 9.80665 m/s^2
Electron Mass	Me	Me = 9.10938188E-31 kg
Proton Mass	Mp	1.67262158E-27 kg
Neutron Mass	Mn	1.67492716E-27 kg
Speed of Light	c	299,792,458 m/s

Note that these pre-defined constants can be re-defined (see the section on Memory for more information).

Memory

powerOne Graph has three kinds of memory: storage memory, system clipboard and variables. In addition, calculated information can be recalled via two methods: last answer and history list.

Storage Memory

powerOne Graph has ten (10) memory locations for quick storage of functions or values. To **store** a function or value to memory, choose the button labeled “STO” and select one of the ten (0 through 9) memory locations from the pop-up list. To **recall** a storage memory location, choose the button labeled “RCL” and select one of the ten memory locations from the pop-up list. These calculators show the contents of the ten memory locations for easy viewing.

The content that is stored is based on the current entry field. If there is nothing in the field, the calculator chooses the last calculated answer from the history list. If there is something in the field, it chooses the contents of that field.

System Clipboard

The Edit Menu in the main calculator contains the standard controls for using the system clipboard. This allows the calculator to interface with other applications and provides an additional storage location while within the application.

Function	Shortcut	Comments
Cut	/X	Cuts the selected text to the clipboard
Copy	/C	Copies the selected text to the clipboard
Paste	/P	Pastes the text from the clipboard to the entry field at the cursor position

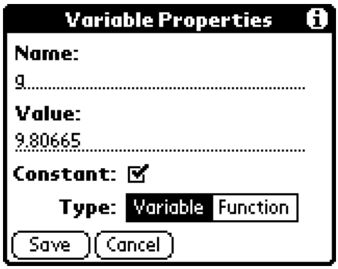
To move information to the clipboard, first highlight the text to cut or copy before selecting a menu item. To insert text from the clipboard, place the insertion point at the desired location before selecting paste from the menu.

Data

powerOne Graph allows the creation and storage of data to memory. The data can either be individual values (variables), constants (unchangeable values) or functions. There are two methods for storing data to memory:

Using the Variable Properties Dialog

To store a variable to memory, select **store** (STO), "New Data…" and the Variable Properties dialog will appear. Variable names must consist of letters (capital or lower case 'a' through 'z') and optionally, numbers (0 through 9), with a maximum of 11 characters. The variable name is case sensitive (i.e. abc is different from ABC) and it cannot start with a number. The value field will contain a copy of the entry field. Enter the name and value in their respective fields. Values can either be entered as a number (3.5) or as an expression (3*x–4). To save the expression, select "Function". To save the number (or result of the expression), select "Variable". The "Constant" checkbox will make the variable unchangeable from the entry field. Constant variables and functions can only be edited from the Variable Properties dialog.



To view and modify existing variables and functions, select store (STO) or recall (RCL) and then "More Data…". The Data worksheet will display. This worksheet will show all variables, functions and constants that have been defined. Choose to see variables, constants or functions by selecting one from the pop-up list in the upper, right-hand corner.

Selecting data will display a list of choices:

- **Use**: recall the name to the entry field for use in an expression.
- **Edit**: recalls the name to the entry field in edit format. See the section on Using the Entry Field for more. This option is not available for constants.
- **Properties**: shows the data's information in the Variable Properties dialog for editing.
- **Delete**: deletes the data entry.

In the Constant view, selecting the “Default…” button restores the default constant values for the constants that are supplied with the application.

Using the Entry Field

In the main calculator’s entry field, variables and functions can be created and edited as well. These operations are listed under the **mem** category on the function bar:

Operation	Display	Comments
Store Function	:=	Stores a function with the given name
Store Variable	=	Stores a variable with the given name

The Store Function operation, while displaying only the answer when evaluating, stores a function in memory. The store variable operation stores only the answer.

For example, a recurring function may be defined as 3*x+4 where x changes. Compute this function for both x equals 5 and 15:

Key	Display	Comments
CLR		
x = 5	x [=] 5 [ENTER]	5 is now stored in variable x
y := 3*x+4	y [:=] 3[*] x [+] 4 [ENTER]	3*x+4 is now stored in variable y and the output is 19 (3*5+4)
x = 15	x = 15 [ENTER]	15 is now stored in variable x
y	y [ENTER]	49 is the output (3*15+4)

Last Answer

powerOne Graph will automatically enter the last answer if a valid math operator is selected at the beginning of an equation to evaluate.

For example, to calculate 3+57 and then multiply this by 15, perform the following keystrokes:

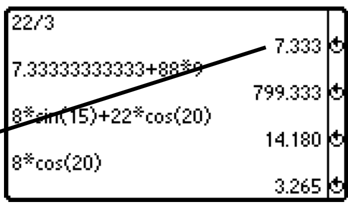
Key	**Display**	**Comments**
CLR		
3	3	
+	3+	
57	3+57	
Enter	60	
x	60*	Multiplication
15	60*15	
Enter	900	

A valid math operator is any operator that requires a value before it in order to calculate correctly, and it is the first item selected for the new equation.

History List

The history list displays the last entry from the entry field as well as the answer or error message associated with that entry. Tapping the history quick-hit button will display the last four entry and answer combinations in a pop-up window. Selecting an item from the history list or from the history pop-up window will insert the text into the entry line at the insertion point.

Select to insert result as shown in the history list, i.e. 7.333



Select to insert the full result (or see the matrix or table), i.e. 7.333333333333

To see the full result of the item in the history list, select the full result button. If it is a value, the full precision of the item will insert in the entry line. If the item is a matrix or table, the display will switch to its view.

Data Types

powerOne Graph can handle various data types including standard numbers, complex numbers, matrices and table data. This section describes each data type. For more details on individual functions, see the Function List section.

Boolean

Boolean values are either "true" or "false".

Integer

Integers are numbers with no fractional portion. In powerOne Graph, integers are whole numbers with a base following the number. The integer numbers are in the range –2,147,483,648 to 2,147,483,647 or -2^{31} to $2^{31}-1$. The bases are as follows:

- **b (Binary)** : Binary numbers are base two integers. Numbers can only have ones and zeros. (e.g., 1011b)
- **o (Octal)** : Octal numbers are base eight integers. Numbers can have digits from zero to seven. (e.g., 374o)
- **d (Decimal)** : Decimal numbers are the common base used to describe numbers. Numbers are base ten and can have digits from zero to nine. (e.g., 213d)
- **h (Hexadecimal)** : Hexadecimal numbers are base 16 integers. Numbers can have digits from zero to 15, with 10 through 15 represented as A through F. These values must always begin with a numerical digit. (e.g., 7FFFh or 0A3Fh)

To create an integer, enter a number with no fractional part and add the letter corresponding to the desired base.

Double

Doubles, also known as real numbers, are floating point numbers stored in IEEE-754 double-precision format. These numbers commonly have a fractional part. In powerOne Graph, numbers

without a base are assumed to be doubles. Most calculations in powerOne Graph use this type. (e.g., 215.56)

Date

Date type is used within the calculator to represent a date. While it cannot be seen in a worksheet or in the entry field, it can be used when calculating values. When entering dates, there are two formats:

- Date dd.mmyyyy: 2 digit day, 2 digit month, 4 digit year
- Time hh.mmssmmm: 2 digits each for hour, minutes, and second, 3 for millisecond. Hour is entered in military time (0-23 hours). (e.g. 1:30pm would be 13.30)

Complex

Complex numbers consist of two doubles that specify real and imaginary parts. Both rectangular and polar complex numbers can be used in powerOne Graph. Rectangular and polar number formats are as follows:

- Rectangular: (real; imaginary) and (real + imaginary * i)
- Polar: (r; @θ) and (r * e^(θ * i))

String

Strings are a combination of characters ('a' through 'z', capital or lower-case, and numbers '0' through '9') within quotation marks. (e.g., "foobar" or "example1").

List

A list is a series of data. Data in a list can be in the any one of the following formats: boolean, integer, double, complex, date or string. Placing braces around a series of numbers separated by semi-colons creates a list. (e.g., {34; 23; 15; 8})

Table

Tables are multiple lists. Data in a table can be any one of the following formats: boolean, integer, double, complex, date or string. Placing braces around a series of lists separated by semi-colons creates

a table. In a table, each row must have the same number of elements. (e.g., { {23; 34; 15}; {5; 8; 84} })

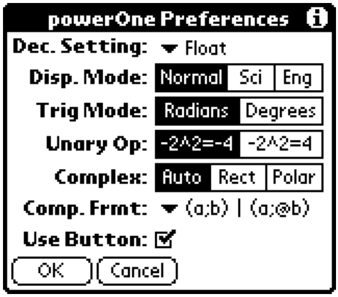
Vector

A vector is a series of numbers. Numbers in a vector can be any one of the following formats: boolean, integer or double. Placing brackets around a series of numbers separated by semi-colons creates a vector. (e.g., [3; 4; 5; 6])

Matrix

Matrices are multiple vectors. Numbers in a matrix can be any one of the following formats: boolean, integer or double. Placing brackets around a series of vectors separated by semi-colons creates a matrix. In a matrix, each row must have the same number of elements.
(e.g., [[1; 2; 3]; [7; 5; 6]])

Preferences



The Preferences screen sets preferences for the main calculator. Reach the preference's screen by selecting powerOne Prefs from the powerOne button or choose Preferences from the Options menu.

powerOne Graph has seven preferences:

- **Dec Setting**: the number of decimal digits in the answer. Float or 0 through 11 can be chosen. Float is the default and means that powerOne Graph will display as many places as possible.
- **Disp Mode**: sets the display mode to either normal floating point, scientific (3.5123E04) or engineering (35.123E03). Engineering mode uses the decimal setting to determine the number of significant digits displayed (1 + decimal setting) and then adjusts the exponent to be a multiple of 3.
- **Trig Mode**: calculates trigonometric functions as either radians or degrees.
- **Unary Op**: determines whether the negative sign has higher or lower precedence than power operations. Texas Instruments calculators say $-2^2 = -4$ while Hewlett-Packard calculators say $-2^2 = 4$.
- **Complex**: sets the type of complex number to be displayed. Choose between auto, rectangular or polar. In auto mode, the calculator will display a complex number in rectangular or polar format depending on the operation performed.
- **Comp. Frmt**: sets the format in which a complex number is displayed.
- **Use Calc Button**: checking this box changes the on-screen calculator button (at the upper, right-hand corner of the Graffiti input area) to powerOne Graph.

Using the Worksheets

powerOne Graph uses worksheets to perform computations. This section details general use of worksheets other than graphing and matrix (see their sections elsewhere for details). See the section on each worksheet for details on that specific computation. Finally, see the Appendix for information on errors.

Accessing the Worksheets

To access a worksheet, choose a category from the worksheet bar in the top, right-hand corner of the display. This list scrolls right and left with the scroll arrows. For faster access, choose the worksheet quick hit button to the right of the worksheet bar. This will list all categories within the application. The following worksheets are available on initial use, listed by category:

Graphing (Graph)

- Enter Equation
- Equations
- Graph
- Window
- Range
- Preferences

Solver (Equation Solver)

- New Worksheet
- My Worksheets
- (Any solver worksheets left in the unfiled category will display after “My Worksheets”)

Matrix

- New Matrix
- Matrices

Convert (Conversion)

- Area
- Energy
- Force
- Length
- Mass
- Pressure
- Temperature
- Velocity
- Volume

Stats (Statistics)

- Stats

Calendar

- Date
- Time

Business

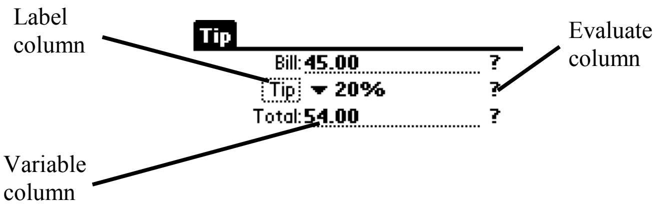
- Discount
- Markup
- Percent Change
- Sales Tax
- Tip
- Time Value of Money (TVM)

Worksheet Structure

All worksheets are similar in nature:

- Each worksheet has a **Clear** button which sets the data back to its original state.
- To exit the worksheet, select **Done**.
- Most worksheets (excluding the calculation log and memory worksheets) contain a menu. See Worksheet Menus for more information.

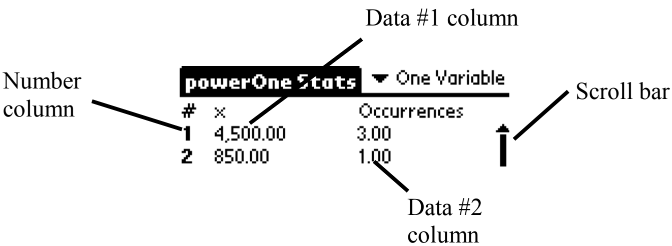
The computation display for each worksheet is also similar. For most worksheets, the data is set in column form:



To enter a value, tap on the value column, enter it in the entry screen, and tap Save. To compute a value, tap the "?" button next to the data to compute.

Some worksheets offer multiple methods of looking at the same variable. In this case, a dotted border called a selection trigger shows around the label. Click on the label to change the variable. For example in the Tip worksheet, the tip can either be an amount entered with the input screen (Tip$), a percentage defined by a pop-up list (Tip), or a general percentage entered with the input screen (Tip%).

The statistics worksheet is slightly different:



Since this worksheet requires both data and computations, the top half of the worksheet allows for data entry (as shown in the picture) while the bottom half allows for computations. To enter a data point, select

a location from data column 1 or 2. To **insert**, **remove**, or **clear** a data point, select the number column and a list choice. There is a maximum of 99 total data sets (numbered 1 through 99). Use the scroll bar to move up and down (the scroll buttons are inactive in these worksheets). Additionally, the calculations for this worksheet may also have a scroll bar, which list additional computations.

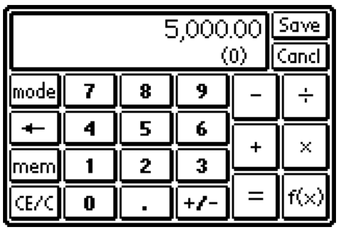
Entering Data

In the worksheets, data is entered using the input screen, date selector or time selector, depending on the type of data requested. The date and time selectors are similar to those used in other Palm OS applications (except that powerOne Graph allows for a change in the date's year with Graffiti and a date range between 1900 and 3000). The input screen is unique to the powerOne line of calculators.

Input Screen

The input screen is used to enter values in the worksheets. Many of the math functions available on the main calculator are also available in the input screen.

When a value is selected, that value appears in the input screen. The keyed function buttons work similarly to those in the main calculator. A menu is also available, which functions in the same way as the main screen's. See Performing Arithmetic for more information.

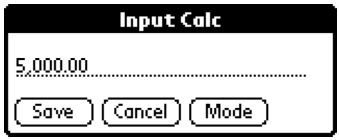


There is a difference between the number on the display and the number stored internally. The internally stored number is always accurate to 15 significant digits.

The f(x) list contains commonly used basic math functions. See the section on Performing Arithmetic for information on using each of these functions.

To exit the input screen, tap **save** to store the view window's value for worksheet calculations or tap **cancel** ("Cancl") to disregard the value. Some variables cannot be saved. In this case, the worksheet disregards the value whether save or cancel is selected. Remember, save and cancel are specifically used for saving to the worksheet itself. Use the memory functions for storing values for later computation.

While the keypad allows for Graffiti keystrokes, additional functionality may be required. By selecting the **mode** button, the keypad can be changed to a text entry field. All functions available to the solver are available to the text input screen. For example, rather than simply entering "4" on the line, an expression can be entered (such as "2 * 2") to calculate an answer. Pressing "Save" evaluates the expression before returning to the worksheet. Selecting mode again will toggle back to the keypad.



Worksheet Menus

Choosing the menu button (in the lower, left-hand corner of the Graffiti® input area) accesses the menus:

The Worksheet menu:

Function	Shortcut	Comments
New Worksheet	/N	Starts the Solver
Edit Worksheet	/E	Displays the worksheet in edit mode if it can be edited
Delete Worksheet	/D	Deletes the worksheet if possible
Beam Worksheet	/B	Beams the worksheet if possible
Beam Category		Beams all worksheets in the chosen worksheet's category if possible
Export Worksheet		Exports the worksheet to the desktop on the next synchronization if possible

Export Category		Exports all worksheets in the chosen worksheet's category on the next synchronization if possible
Results to Memo Pad	M	Sends the worksheet's data to the memo pad for easy synchronization

The Options menu:

Function	**Shortcut**	**Comments**
Worksheet Prefs	/W	Displays the Worksheet Preferences
Variable Prefs	/V	Displays the Variable Preferences
Worksheet Notes	/H	Displays online help for the worksheet
About…		Displays company information.

Results To Memo Pad

powerOne Graph allows the export of worksheet information to the memo pad. From the memo pad, it can be synchronized to the desktop, copied to the clipboard, or printed directly.

To use this function, enter variables and compute values first. Once this is completed, choose Results to Memo Pad from the options menu. This will ask for a memo name. Select OK to send to the memo pad or select Cancel to stop the process.

Exporting and Beaming Worksheets

Worksheets that are created using the solver, or downloaded to powerOne Graph through HotSync or beaming, may be exported or beamed. It is easy to send such worksheets to another user. To beam a worksheet, line up Infrared ports on two Palm OS devices and choose Beam Worksheet from the menu (the other user must have an appropriate powerOne product to use the worksheet). Additionally, all user-created worksheets in the current worksheet's category can be beamed by selecting Beam Category from the menu. Note that some

worksheets cannot be beamed – a dialog will appear if that choice is not possible.

To export a worksheet, select Export Worksheet from the menu and enter a file name. The next time the device is synchronized, the file is placed on your computer in the folder Palm(or your device type): user name : Backup. From there, the worksheet can be shared via email, physical media (i.e., floppy disk) or posted on a web site, such as Infinity Softworks's site. The collection is located at www.infinitysoftworks.com/worksheets.

Some additional notes on exporting:

- Multiple worksheets can be saved to the same file even if they have the same name (including duplicates of the same worksheet). This is how export category works – adding an entry to the file for each export-able worksheet within the current worksheet's category.
- Exporting and synchronizing will not delete the worksheet or the created file from the device. Next time a powerOne product is started, a dialog will help with importing. To delete the file, enter powerOne Graph and select "Delete" from the Worksheet Import File dialog.

Installing Additional Worksheets

Infinity Softworks has additional worksheets available for download from its web site (www.infinitysoftworks.com/worksheets). These worksheets function similarly to the built-in worksheets.

To install a worksheet, download it from the web site and double-click its icon to start the Palm Install Tool. See your device user manual for more information on using the Palm Install Tool. After synchronizing the device, start powerOne Graph. A dialog will appear for each worksheet to install:

- Choose **import** to import the worksheet into powerOne Graph.
- Choose **delete** to delete the file from the device without installing.
- Choose **ignore** to ignore the file (do not import nor delete).

By default, the worksheet will appear in the same category in which it was saved (if the creator had it in the Business category, it will appear in your Business category). To move it, see the section on Worksheet Preferences.

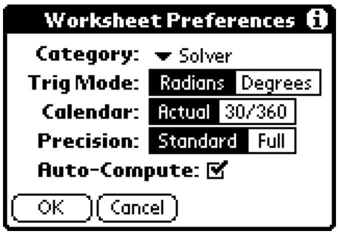
Note that some worksheets may require additional function libraries, such as the powerOne Finance Library. These libraries are available during the powerOne Graph installation process as an optional component.

Preferences

Worksheets contain two sets of preferences, one for the worksheets and one for each variable within the worksheet.

Worksheet Preferences

Each of these preferences refer to the currently selected worksheet.



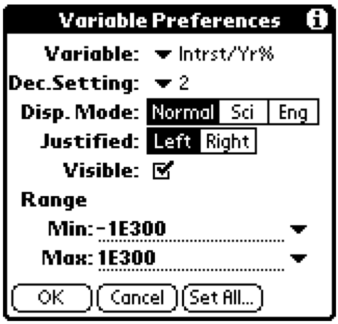
- **Category**: category for the worksheet. Most worksheets can be moved to any category. Beyond the built-in categories, powerOne Graph offers the ability to create 9 additional categories by choosing "Edit Categories…" from the pop-up list. These custom categories appear in alphabetical order following the built-in categories within the main calculator's worksheet bar.
- **Trig Mode**: allows trigonometric operations to be done in either degree or radian mode if it is not defined by the worksheet.
- **Calendar**: allows date arithmetic to be performed using an actual or 30/360 calendar. Some worksheets allow for this change directly in the worksheet itself.
- **Precision**: some calculations require an iterative search for the answer (i.e., TVM interest rates) and take more than 1 second to calculate. When this occurs, a Computing dialog will appear. Precision affects the time of the calculation. Setting it to Full will

calculate until full precision is reached. Setting it to Standard will only calculate to the displayed decimal places. Full precision takes longer to calculate but is more accurate than standard precision.

- **Auto-Compute**: when checked, powerOne Graph will automatically determine when the “?” should be visible. When a value is entered, a “?” will appear next to any other value which may be affected by the change. When a value is recomputed, the question marks will disappear. While this is checked, powerOne Graph will also automatically recalculate any values it can after each change. For example, if a worksheet uses the formula “x=y/2” and you enter the value 6 for y, then x will be automatically computed to be 3, and the “?” for each will be cleared. If unchecked, the compute “?” will remain visible at all times, and values will only be recalculated when you tap their “?” button.

Variable Preferences

Each of these preferences refer to the variables within the currently selected worksheet. To set the preferences for a variable, first choose it from the Variable pop-up list. Selecting “Set All” will set all the variables to the currently showing variable’s preferences.



- **Variable**: the variable to set.
- **Dec Setting**: sets the displayed decimal places:: float mode displays all available decimal places, 0-11 sets the decimal places at that number of places.
- **Disp. Mode**: numbers can be displayed in normal mode, scientific notation or engineering notation. See Preferences for the Main Calculator for details.
- **Justified**: show the value left or right justified on the display.
- **Visible**: show the variable if checked. A variable which is hidden will not be recalculated, even if Auto-Compute is checked.

- **Range**: available if the variable requires an iterative search to calculate. The range is the maximum and minimum starting points for calculation. The closer these are, the faster and more accurately a value can be derived. For more on iterative solving, see How the Solver Works in the Creating Worksheets with the Solver section.

Graphing

These worksheets allow for creation and graphing of equations. To access the graphing worksheets, choose Graph from the worksheet bar.

Overview

Graphing an equation on any handheld calculator requires multiple steps. powerOne Graph offers equation creation and graphing in a step-by-step wizard to make repeated use easier.

Equation creation and graphing is split into six core functions: entering an equation, choosing the equations to graph, setting the graph window coordinates, setting the graph range, setting the graph preferences, and graphing.

Equation Types

powerOne Graph supports function, polar or parametric equations. All three equation types can be display simultaneously.

- **Function Equations**: rely on one dependent (y) and one independent (x) variable. It is graphed by plotting the y variable that correlates with the x value.
- **Polar Equations**: have one dependent variable (r) and one independent variable (t). These equations are graphed by mapping r and t to x and y points.
- **Parametric Equations**: have two dependent variables (x and y) that both rely on the same independent variable (t). These equations are graphed by plotting the (x, y) point.

Quick Start

This is a step-by-step example on how to graph an equation. In this case we want to graph the function (x + 1) / (x – 2).

Step 1: Enter an equation

To enter an equation, select **Enter Equation** from the Graph worksheet category. The wizard will begin by asking which type of

graph to enter: function, polar or parametric. For this example, choose **Function**.

Notice that the view window altered. Instead of the history list and entry field, a new entry field appeared defined as “y(x)” along with equals, save and cancel buttons. Also notice that a “x,t” button appeared instead of the EE button along the left-hand side of the display. To enter an equation, make sure the cursor is blinking in the y(x) entry field and enter (x + 1) / (x – 2) as follows:

Key	Display	Comments
(	(	
x,t	(x	powerOne determines whether it needs x or t automatically
+	(x+	
1	(x+1	
)	(x+1)	
÷	(x+1) /	Divide
(	(x+1) / (	
x,t	(x+1) / (x	
–	(x+1) / (x–	
2	(x+1) / (x–2	
)	(x+1) / (x–2)	

After entering, choose **Save**.

Step 2: Equations List

Choosing save displays the next graphing wizard. Choose the second **Go** button (Go to the equation’s worksheet).

powerOne Graph has the ability to store and graph multiple equations at the same time. To control which equations to graph, make sure a check appears in the checkbox to the left of the equation. Make sure the equation (x+1) / (x–2) is checked.

powerOne Graph also has the ability to draw graphs in color (available on color devices only). To change a graph's color, select the box to the right of the equation and choose a new color from the list.

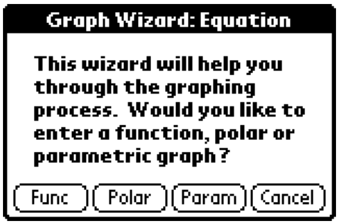
Step 3: Graph

Choose the **Graph** button in the equation's screen. You should see the graph display. Choose **Done** to return to the main calculator or choose **Go** to go to a different graphing function.

Entering Equations

Entering equations (Enter Equation in the graph category) starts a wizard that makes entry and graphing easier.

The first display asks which type of equation to graph. The decision changes the view window of the main calculator. Choosing **func** (function) changes the view window to show a y(x) entry field, along with equals, save and cancel buttons. Choosing **polar** changes the view window to show a r(t) entry field. Choosing **parametric** changes the view window to show both an x(t) and y(t) entry field. Entering the equations and selecting save will store the equation in memory.



Notice that the EE (exponential notation) button along the left-hand side of the keypad also disappears and is replaced with a button labeled "x,t". This button makes entering the appropriate variable easier. powerOne automatically handles whether x or t should be used.

Once Save is selected, a second display asks what to do next. This makes entering a new graph, navigating to the equations worksheet, or graphing easier.

Inequalities

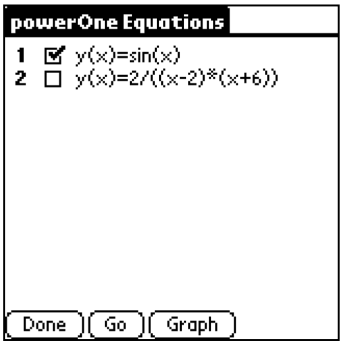
Function equations can be entered as equalities or inequalities. Notice that the "=" is surrounded by a dotted-border button. Selecting it will show a list of possible choices. Options are as follows:

- **= (equals)**: draws the exact line of the equation by plotting a point where the x value evaluates to the y value.
- **<= (less than or equal to)**: draws the exact line of the equation and shades the region below the equation.
- **>= (greater than or equal to)**: draws the exact line of the equation and shades the region above the equation.
- **< (less than)**: shades the region below the equation without drawing the exact line.
- **> (greater than)**: shades the region above the equation without drawing the exact line.

To plot an equation as an inequality, select the "=" button and choose the inequality from the list. Enter the equation as normal and select "Save". When the equation draws, the area will be automatically be shaded.

Equations List

The equations worksheet contains a list of all entered graphs, whether function, polar or parametric. The display shows (from left to right) the equation number, followed by the graphing checkbox, the equation itself, and finally the color used to graph the equation (for color devices only). powerOne Graph can graph multiple equations at the same time. Those equations that are checked will display in the graph worksheet.



At the bottom of the display are three buttons:

- **Done**: returns to the main calculator.

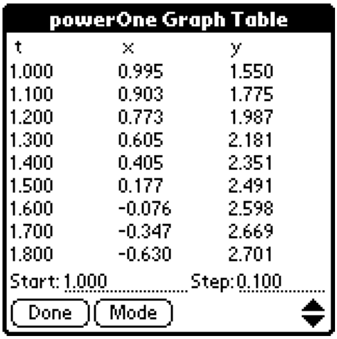
- **Go**: shows a list of other graphing worksheets for fast navigation.
- **Graph**: goes to the graph worksheet and graphs the checked equations.

Selecting an equation offers four options as well:

- **Quick Graph**: graphs the selected equation only.
- **Edit**: recalls the equation to the view window for editing.
- **Delete**: deletes the selected equation.
- **View Table**: shows the graph table for the selected equation. Read the section on Graph Table for more information.

Graph Table

To view a table of data derived from an equation, select the equation and choose “View Table…”. This will display the data starting at the value indicated in “Start” and stepping at the value indicated in “Step”. For function equations, ‘x’ is treated as the independent variable while for polar and parametric equations, ‘t’ is the independent variable. For polar graphs, a **mode** button is present to switch for displaying ‘x’ and ‘y’ to ‘r’.


powerOne Graph Table

t	x	y
1.000	0.995	1.550
1.100	0.903	1.775
1.200	0.773	1.987
1.300	0.605	2.181
1.400	0.405	2.351
1.500	0.177	2.491
1.600	-0.076	2.598
1.700	-0.347	2.669
1.800	-0.630	2.701

Start: 1.000 Step: 0.100

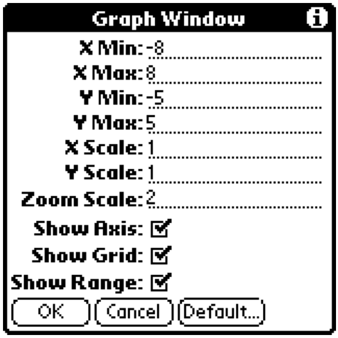
Done Mode

Window Settings

The window settings are used to define the graph window coordinates. The ten variables are defined as follows:

- **X Min**: minimum on the x-axis (horizontal, far left edge of the graph window).
- **X Max**: maximum on the x-axis (horizontal, far right edge of the graph window).
- **Y Min**: minimum on the y-axis (vertical, bottom edge of the graph window).

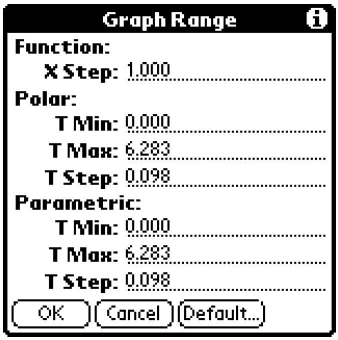
- **Y Max**: maximum on the y-axis (vertical, top edge of the graph window).
- **X Scale**: determines the tick intervals on the x-axis.
- **Y Scale**: determines the tick intervals on the y-axis.
- **Zoom Scale**: ratio to jump when zooming in or out in the graph worksheet
- **Show Axis**: check this box to show the axis.
- **Show Grid**: check this box to show the grid.
- **Show Range**: check this box to show the range values.



Choose **OK** to save the settings, **Cancel** to throw the changes away or **Default** to restore the default settings.

Graph Range Settings

The graph range settings define the limits used in plotting equations. The following range settings are available:



Function

- **X Step**: controls how a function is plotted. The range is 1 to 8, where a value of 1 plots every point and a value of 8 will plot every eighth point.

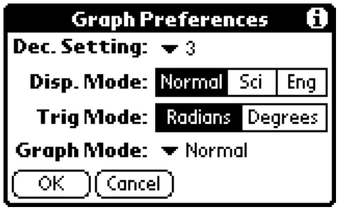
Polar

- **T Min**: starting point of a polar equation.
- **T Max**: ending point of a polar equation.
- **T Step**: sets the absolute theta value increment for evaluating x and y from the polar equation.

Parametric

- **T Min**: starting point of a parametric equation.
- **T Max**: ending point of a parametric equation.
- **T Step**: sets the absolute T value increment for evaluating x and y from the parametric equations.

Graph Preferences



The graph preferences define additional graph settings. The following preferences are available:

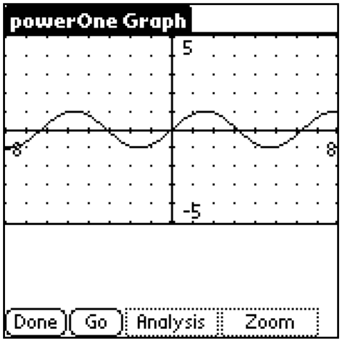
- **Dec. Setting**: the number of decimal places to use in viewing a number.
- **Disp. Mode**: the format to display a number. Numbers can be viewed in normal, scientific or engineering formats.
- **Trig Mode**: the graphing worksheets can evaluate trigonometric functions in either degrees or radians.
- **Graph Mode**: the method to use in plotting an equation. Normal mode will draw a graph from left to right. Phase mode will plot the points on the graph and connect the lines after each point is plotted (this can be used only in function equations). Dots mode will draw only the points on the screen.

Graph Worksheet

The graph worksheet is where graphing and equation evaluation occurs. The screen is split into two sections. The top portion of the screen is the graph window. The bottom portion of the screen is used for navigation and evaluation. The following buttons are visible:

- **Done**: returns to the main calculator.
- **Go**: shows a list of other graphing worksheets for fast navigation.
- **Analysis**: puts the graph into the selected analysis mode. See its section below for more details.

- **Zoom**: tap to display a list of zoom choices. See its section for more details.



Analysis Mode

powerOne Graph offers eight methods of analyzing an equation. To use an analysis mode, choose the "Analysis" button and select a mode from the list. In all analysis modes, underlined numbers can be edited. To change the equation used, select the equation and choose a new one from the equation list or use the up and down scroll buttons. The selected mode will be displayed in the analysis button.

Some analysis modes require a box to be drawn. To draw a box on the graph, press down in the top, left-hand corner and drag to the lower, right-hand corner without lifting the stylus.

The modes are as follows:

- **Trace/Eval**: Trace/Eval mode displays the coordinates for the current cursor location on the graph. To evaluate a different point, either click on the graph or, to move one point at a time, select the left and right on-screen scroll arrows. To find the value at a given point, select the x field for function equations or the t field for polar and parametric equations and enter in the input screen.
- **Y Intercept**: This mode can be used for function graphs only. It displays the value for y when x is zero. The y intercept is automatically displayed when entering this mode or selecting a new equation.
- **Roots**: This mode can be used for function graphs only. It finds a value for x when y is zero. To find the root of an equation, select the equation and draw a box on the screen where the equation crosses the x axis. If the root can be found, it will be displayed in the x and y fields.

- **Intersection**: This mode can be used with function graphs only. When two equations are displayed in the graph window, this function can locate the intersection. To find the intersection point, select the first equation into the top drop list and the second equation into the second drop list, draw a box on the screen around the point where the equations intersect. The intersection point will be displayed in the x and y fields.
- **Derivative**: This function calculates derivatives in the following form: function equations are dy/dx, polar equations are dy/dx and dr/dt, parametric equations are dy/dx, dy/dt, and dx/dt. If a function equation is selected, the x field will appear. For polar and parametric equations, the t field is displayed. To change the value in the x and t fields, select the number and edit in the input screen or click on the graph and move the cursor.
- **Integral**: Integral mode can be used with function equations only. To find the numerical integral of an equation, the lower and upper bounds must be set: change the lower ("l") and upper boundaries ("u") by either changing their values in the input screen or draw a box on the screen around the portion of the graph to be integrated. Once the boundary parameters are set, choose the integral ("∫") button.
- **Minimum**: This mode can be used with function equations only. To find a minimum point of an equation, draw a box around the portion of the graph to be analyzed. The minimum point will be displayed in the x and y fields.
- **Maximum**: This mode can be used with function equations only. To find a maximum point of an equation, draw a box around the portion of the graph to be analyzed. The maximum point will be displayed in the x and y fields.

Zoom Mode

To choose a zoom mode, select the **zoom** button. powerOne Graph allows five different zoom modes:

- **In**: zooms in the by the amount set for "Zoom Scale" in the Graph Window settings.
- **Out**: zooms out by the amount set for "Zoom Scale" in the Graph Window settings.

- **Center**: redraws the graph view with the selected point at the center of the screen.
- **Box**: zooms to the boxed area of the screen.
- **Default**: zooms to the default settings.
- **Square**: attempts to adjust the x and y maximum and minimum so the change of x is the same as the change of y. For example, this will make the graph of a circle look like a circle.

To zoom in, out, or center choose one so “Zoom In”, “Zoom Out”, or “Zoom Ctr” appears in the ”Zoom” button, then select a location in the graph. powerOne Graph will attempt to place the selected location in the center of the new display. These modes stay on until another mode is selected. In other words, selecting the display multiple times will continue zooming at the selected location.

To zoom box, choose “Zoom Box” from the zoom button. Then, starting from the top, left-hand corner and dragging to the bottom, right-hand corner, create a box on the display around the graph area to display in more detail. powerOne Graph will change the graph display to be the drawn area. Note that this mode stays on until another mode is selected. In other words, selecting a new box multiple times will continue to alter the graph.

All other zoom functions happen immediately on selection.

Plotting

powerOne Graph offers a method of plotting data. To plot a set of data, two steps are required:

Step 1: Create a Table

Use the entry field to create a table. Two simple methods are as follows:

- **Define the table by hand using braces (“{“ and “}”)**: For example, entering “A = {34; 45; 23; 15; 18}” (without quotes) creates a single column table “A”, with the five rows containing the above values.

- **Use a function that creates a table**: For example, entering "A = seq("x+1"; "x"; 0; 10)" (without the outermost quotes) will assign the values "1" through "11" to table "A". See the Function List section for more information.

Step 2: Set the Graph Equation

To plot the data, create a new function graph and use the function call "getItem" from Matrix on the function bar. The steps to set the equation for table "A" above is as follows:

- Choose "Enter Equation" from Graph on the worksheet bar.
- Choose "Func" (function) from the wizard.
- Enter "getitem(A; x)" in the entry field. getItem can be accessed from Matrix on the function bar.
- By changing the "=" sign to "<=", the plot will show as a bar graph: instead of a series of lines.
- Select "Save" and "Go to the equation worksheet".

Step 3: Set the Window

Once the equation is set, change the Window Settings so the plot takes the entire screen. Choose "Go" and then "Window" to set them.

The following values need to be changed:

- **X-Min**: will always be 1.
- **X-Max**: the number of data points plus one. In this example, either enter 6 or use the text input field and enter "countx(A)+1" (without quotes) to calculate automatically.
- **Y-Min**: the minimum value in the list. In this example, either enter 15 or use the text input field and enter "min(A)" (without quotes) to calculate automatically.
- **Y-Max**: the maximum value in the list. In this example, either enter 45 or use the text input field and enter "max(A)" (without quotes) to calculate automatically.

Select OK when completed to return to the Equation List.

Step 4: Graph It!

To see the bar chart, make sure only this equation is selected for graphing and select the “Graph” button. All of the analysis modes are available.

Examples

Circle: Graph a circle with radius 4. What is the area of the circle? The equation for drawing a circle is $y^2 = r^2 – x^2$ where r is the radius.

To perform this calculation, enter two equations to graph the circle, use Zoom Square to make the graph look like a circle, and the integral function to determine its area. Start from the main calculator.

Entering the Equations:

- Choose “Enter Equation” from the Graph worksheet bar category.
- Choose “Func” for function equation from the wizard.
- Enter “sqrt(16 – x^2)” (without quotes) for the equation and select “Save”. This equation draws the top half of the circle.

- Choose “GO enter another equation” and “Func” for function equation from the graph wizard.
- Enter “–sqrt(16 – x^2)” (without quotes) for the equation and select “Save”. This equation draws the bottom half of the circle.
- Choose “GO to the equation worksheet”. In the Equation List, make sure only these two equations are checked.

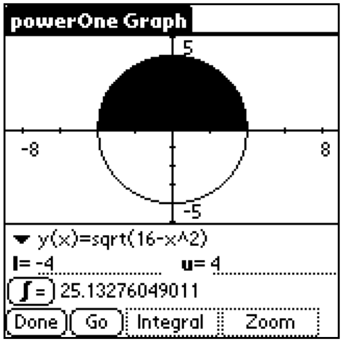
Graph the Circle:

- Graph the circle by selecting the “Graph” button at the bottom of the Equation List. An oblong will graph on the display.
- To make it appear circular, select the “Zoom” button and choose “Square”. This will make change of x and change of y equal.

Find its Area:

- Choose “Integral” from the “Analysis” button.

- Click the line next to “l” and enter –4 for the lower bound. Save.
- Click the line next to “u” and enter 4 for the upper bound. Save.
- Select the Integral (“∫”) button. Notice that the top half of the graph fills in and an integral answer of 25.13276 appears. This is the area for half the circle.



- To determine the area for the entire graph, click on the integral value (25.13276) and multiply by 2 in the input screen.
- The area of the circle is 50.26552.

Sine Curve: What are the maximum and minimum points on a sine curve?

To perform this calculation, use the equation sin(x) along with the Min and Max features to determine the correct points. Start in the main calculator.

Entering and Graphing the Equation:

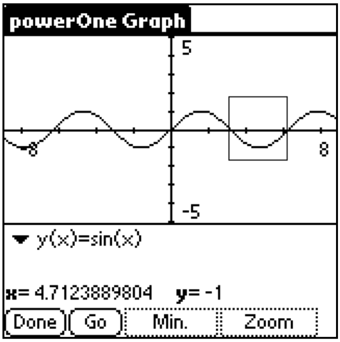
- Choose “Enter Equation” from the Graph worksheet bar category.
- Choose “Func” for function equation from the wizard.
- Enter “sin(x)” (without quotes) for the equation and select “Save”.

- Choose “GO to the equation worksheet”. In the Equation List, make sure only this equation is checked.
- Select the “Graph” button at the bottom of the Equation List.
- Choose “Default” from the “Zoom” button.

Find its Minimum Point:

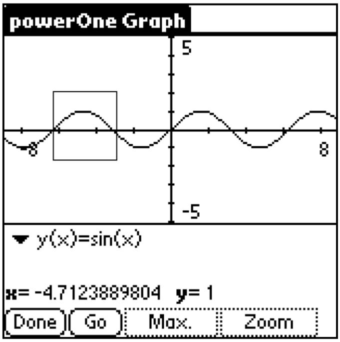
- Choose “Min” from the “Analysis” button.

- On the graph itself, choose a small area that visibly contains the minimum data point. Start in the top, left-hand corner by clicking down with the stylus and drag across to the bottom, right-hand corner before lifting up.
- The minimum point is y = –1.



Find its Maximum Point:

- Choose “Max” from the “Analysis” button.
- On the graph itself, choose a small area that visibly contains the maximum data point. Start in the top, left-hand corner by clicking down with the stylus and drag across to the bottom, right-hand corner before lifting up.
- The maximum point is y = 1.



Projectile Motion: With an initial velocity of 30 meters per second (m/s) and shooting at a 25º angle, approximately how far does the object fire and how long is it in the air?

To perform this calculation, the following physics equations are used:

$$x(t) = t * v_o * \cos(\theta)$$
$$y(t) = t * v_o * \sin(\theta) - 0.5 * g * t^2$$

where t is time, v_o is initial velocity, g is the gravity constant (9.8 m/s^2) and θ is angle to fire. The gravity constant is already designated

in the application, so we can use it as a constant in our formula as well.

To calculate this parametric graph, first enter the equation, set the graph preferences, range and window settings, and finally estimate the distance with the Trace/Eval function.

Entering the Equation:

- Choose “Enter Equation” from the Graph worksheet bar category.
- Choose “Param” for parametric equation from the wizard.
- Enter “t * 30 * cos(25)” for x(t)” (without quotes).
- Enter “t * 30 * sin(25) – 0.5 * g * t^2” for y(t)” (without quotes).
- Select “Save”.
- Choose “GO to the equation worksheet”. In the Equation List, make sure only this equation is checked.

Change the Graph Preferences:

- Select “Go” at the bottom of the display and choose “Preferences”.
- Make sure Trig Mode has “Degrees” highlighted instead of “Radians”.
- Select “OK”.

Change the Graph Range:

- Select “Go” at the bottom of the display and choose “Range”.
- Under Parametric, change the following values:
  T Min = 0
  T Max = 5
  T Step = 0.1
- Select “OK”.

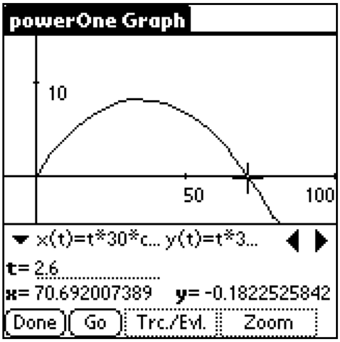
Change the Window Settings:

- Select “Go” at the bottom of the display and choose “Window”.
- Change the following settings:
  X Min = –10

X Max = 100
Y Min = –5
Y Max = 15
X Scale = 50
Y Scale = 10

- Select “OK”.

Graph and Analyze:



- In the Equation List, make sure only this equation is checked.
- Select the “Graph” button at the bottom of the display.
- Choose “Trace / Eval” from the “Analysis” button.
- Click and drag the cross-hair until the graph crosses the x-axis.
- The distance until the object hits the ground is approximately 70 meters (the value for “x”).
- The time the object is in the air is approximately 2.6 seconds (the value for “t”).

Polar Rose: Graph a polar rose. The equation for graphing a rose is R = A * sin(B* θ). For this example, assume A = 4 and B = 2.5.

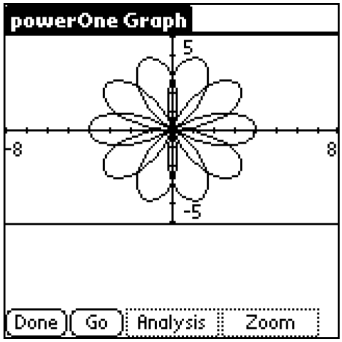
Start from the main calculator.

Entering the Equation:

- Choose “Enter Equation” from the Graph worksheet bar category.
- Choose “Polar” for polar equation from the wizard.
- Enter “4 * sin(2.5 * t)” (without quotes) for r(t).
- Select “Save”.
- Choose “GO to the equation worksheet”. In the Equation List, make sure only this equation is checked.

- Select the “Graph” button at the bottom of the display.

Change the Graph Preferences:
- Select “Go” at the bottom of the Graph Window and choose “Preferences”.
- Make sure Trig Mode has “Radians” highlighted instead of “Degress”.
- Select “OK”.



Change the Zoom Settings:
- Choose “Default” from the “Zoom” button.

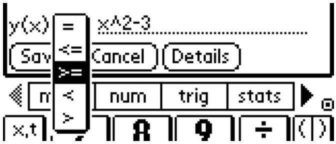
Change the Graph Range:
- Select “Go” at the bottom of the display and choose “Range”.
- Under Polar, selecting T Max and choose “Mode” in the input screen to change to text input. Clear the field and enter “4 * pi” in the entry field and select “Save”.
- Select “OK”.

Intersections and Inequalities: Where do the equations “x – 1” and “x^2 – 3” intersect?

To demonstrate this problem mathematically and visually, both the intersection and inequality functions will be used. Start from the main calculator.

Entering the Equations:
- Choose “Enter Equation” from the Graph worksheet bar category.
- Choose “Func” for function equation from the wizard.
- Enter “x – 1” (without quotes) for the equation, select the “=” sign and change to “<=”, and select “Save”.
- Choose “GO enter another equation” and “Func” for function equation from the graph wizard.

- Enter "x^2 – 3" (without quotes) for the equation, select the "=" sign and change to ">=", and select "Save".
- Choose "GO to the equation worksheet". In the Equation List, make sure only these two equations are checked.

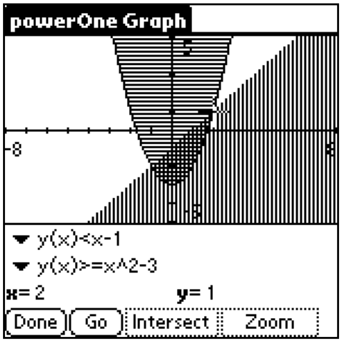


Graph the Equations:

- Graph the equations by selecting the "Graph" button at the bottom of the Equation List. Two graphs with shading will appear.
- To make sure it appears correctly on the display, select the "Zoom" button and choose "Default".
- Visually, it is easy to see where the two areas intersect each other on the display. It is also easy to see where the two equation lines intersect: one in the positive-x/positive-y quadrant, the other in the negative-x/negative-y quadrant.

Find the Intersection Point:

- Choose "Intersection" from the "Analysis" button.
- On the graph itself, choose a small area where the two equation lines intersect. Start in the top, left-hand corner by clicking down with the stylus and drag across to the bottom, right-hand corner before lifting up.
- The equations cross at two points: x = 2, y = 1 and x = –1, y = –2.



Plotting: Given the average temperature per month, show a bar graph and determine the average yearly temperature:

January: 42	February: 45	March: 52
April: 64	May: 72	June: 77
July: 83	August: 86	September: 74
October: 61	November: 53	December: 44

To perform this calculation, create a table in the main calculator with the data points, graph that data and change the window settings, then use the integral function to help calculate the average yearly temperature.

Create a Table:

- In the main calculator, enter "Temp = {42; 45; 52; 64; 72; 77; 83; 86; 74; 61; 53; 44}" (without quotes). The braces "{ }" can be found by selecting stats from the function bar.
- Choose "Enter".

Entering the Equation:

- Choose "Enter Equation" from the Graph worksheet bar category.
- Choose "Func" for function equation from the wizard.
- Enter "getitem(Temp; x)" (without quotes).
- select the "=" sign and change to "<=".
- Select "Save".
- Choose "GO to the equation worksheet". In the Equation List, make sure only this equation is checked.

Change the Window Settings:

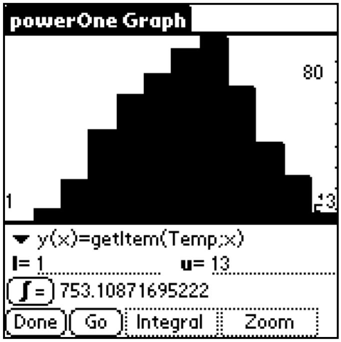
- Select "Go" at the bottom of the display and choose "Window".
- Change the following settings. powerOne Graph can automatically calculate the values. Select "mode" to show the text input screen instead of the calculator:
  X Min = 1
  X Max = "countx(Temp) + 1" (without quotes)
  Y Min = "min(Temp)" (without quotes)
  Y Max = "max(Temp)" (without quotes)

X Scale = 1
Y Scale = 5

- Select "OK".

Find the Average Yearly Temperature:

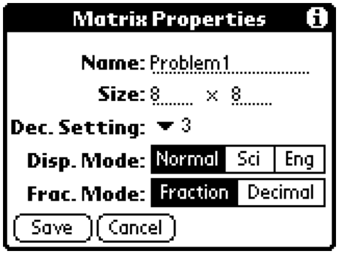
- Choose "Integral" from the "Analysis" button.
- Click the line next to "l" and enter 1 for the lower bound (January is the 1st month). Save.
- Click the line next to "u" and enter 13 for the upper bound (December is the 12th month and add 1 to include that month). Save.
- Select the Integral ("∫") button. Notice that the bar graph fills in and returns an answer of 753.109. This is the area under the curve or, in this case, the averages for each month added together.



- To determine the yearly average temperature, select 753.109 so it appears in the input screen and divide by 12. The average temperature is 62.76 degrees.

Matrices

These worksheets allow for creation and editing of matrices. To access the matrix worksheets, choose "Matrix" from the worksheet bar.



New Matrix

To create a matrix, select **New Matrix** from the **Matrix** worksheet bar. The Matrix Properties form will be displayed. A matrix must have a name and size to be successfully created. Matrices must have less than 2500 elements. The Matrix Properties worksheet has the following elements:

- **Name**: the name can be 31 characters consisting of letters and numbers but must begin with a letter.
- **Size**: the first field is for the rows, the second field is for the columns.
- **Dec Setting**: the number of decimal places that displayed for each element of the matrix. Float or 0 through 11 can be chosen. Float is the default and means that powerOne Graph will display as many places as possible.
- **Disp Mode**: sets the display mode to either normal floating point, scientific, or engineering .
- **Frac. Mode**: sets the method used for displaying numbers either as fractions or decimals. Numbers that cannot be converted to fractions will be displayed as decimals in float format.

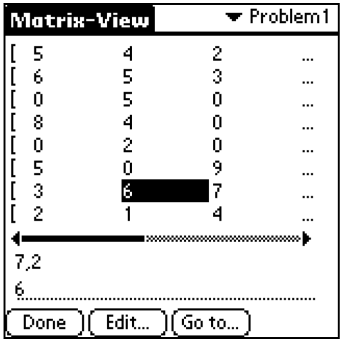
Matrix List

Selecting Matrices from the Matrix worksheet bar will access the Matrix

List. The Matrix List displays all of the entered matrices and the size of each. To create a new matrix, choose the “New…” button. To use, view, edit or delete a matrix, or view the matrix’s properties, select the matrix and choose the desired option from the list. Choosing “Use…” will return the name to the main calculator for use in a calculation. Choosing “View…” will take you to the “Matrix–View” : and “Edit…”: to the “Matrix–Edit” displays, respectively. “Properties” will display the matrix properties and “Delete…” will delete the selected matrix.

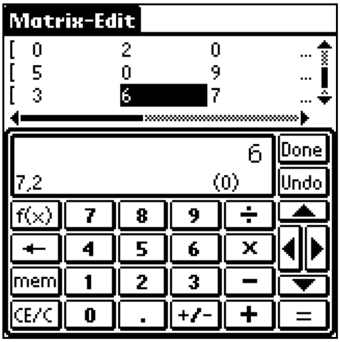
Matrix View

This display provides a larger viewing area and includes a command line entry for editing matrix elements. If the matrix is larger than the available display, scroll arrows appear. To enter data in a cell, choose the cell and enter the data on the command line. This data can either be a value or an expression and will update the cell after the data is entered. Note that the selected cell coordinates appear in the lower, left-hand corner of the matrix (row, column). To move easily to the Matrix–Edit display, choose the “Edit…” button. To exit this view, choose the “Done” button. powerOne Graph makes it easy to navigate through a matrix in the Matrix–View display. If the matrix is larger than the display size, the scrollbars can be used. To quickly move to a specific coordinate, choose the “Go to…” button. Enter the row and column to navigate to and choose “OK”. The matrix size is displayed in the lower, right-hand corner for reference. Finally, in the upper, right-hand corner of the Matrix–View display, a list of matrices is available. Move between them by choosing the pop-up list and selecting the desired matrix.



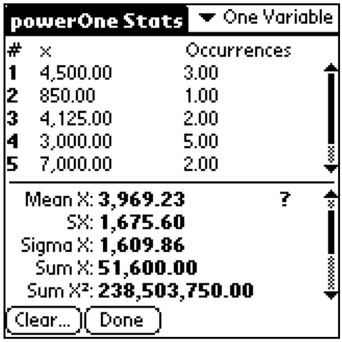
Matrix Edit

The second method of viewing and editing data is the Matrix–Edit display. This display offers a calculator and a more limited viewing area. Scroll the view area with the scroll bars. Note that the currently selected matrix location is displayed in the lower, left-hand corner of the calculator view window. Use the calculator buttons as a standard calculator. The "f(x)" button provides advanced math functions. Use the arrow buttons to move the currently selected cell or tap the cell directly in the matrix. Before scrolling, powerOne Graph will save the current value in the view window to the current selected cell. To throw away changes before moving, choose the **undo** button. To save the entry for the current field and exit this display, choose the **done** button.



Statistics

This worksheet analyzes statistical (stat) data sets. It is useful for forecasting and performing market data analysis with its ability to calculate mean, standard deviation, and compute regression analysis, among other computations. The statistics worksheet is capable of analyzing both one and two-variable statistical data.



The Display

Select a statistics computation method from the pop-up list in the top, right-hand corner. To perform one-variable statistics, select that choice. Linear, natural log, exponential, and power are two-variable regression methods.

To perform a statistics problem, data must be entered. The top section of the worksheet is for data entry while the bottom section is for computations. From left to right, the columns are:

- **Number (#)**: the statistics number, 1 through 99.
- **x**: the statistic's x-value.
- **Occurrences or y**: the number of occurrences or the statistic's y-value. Occurrences are for one-variable statistics. Each one-variable statistic can occur a maximum of 999 times. Y is for two-variable statistics.

For more on data entry, see Using the Worksheets.

Calculations

There are five available regression models. For two-variable statistics, regression models include linear, exponential, natural log, and power. The fifth is one-variable.

To calculate the main statistics, select “?” on the top calculation line. In addition, entering a value for X’ or Y’ and selecting “?” next to the other will calculate it.

An explanation of each variable follows:

Label	Explanation	One-Var
Occ	Number of items	Yes
Mean X	Mean of x values	Yes
SX	Sample standard deviation of x	Yes
Sigma X	Population standard deviation of x	Yes
Sum X	Sum of x	Yes
Sum X^2	Sum of x-squared	Yes
Min X	Minimum x value in the set	Yes
Max X	Maximum x value in the set	Yes
Range X	Max x minus min x	Yes
Mean Y	Mean of y values	No
SY	Sample standard deviation of y	No
Sigma Y	Population standard deviation of y	No
Sum Y	Sum of y	No
Sum Y^2	Sum of y-squared	No
Sum XY	Sum of x times y	No
Min Y	Minimum y value in the set	No
Max Y	Maximum y value in the set	No
Range Y	Max y minus min y	No
A	Regression y-intercept	No
B	Regression slope	No
R	Regression correlation coefficient	No
X’	Predicted x-value	No
Y’	Predicted y-value	No

Regression Models

powerOne Graph uses four different regression models for determining the best fit for curves and forecasting. The X value is considered the independent variable while the Y variable is the dependent one. The formulas used are as follows:

Model	Formula	Restrictions
Linear	$Y = a + b * X$	None
Logarithmic	$Y = a + b * \ln(X)$	All X values > 0
Exponential	$Y = a * b^X$	All Y values > 0
Power	$Y = a * X^b$	All X and Y values > 0

The results are calculated using the following values:

- **Linear**: uses X and Y
- **Logarithmic**: uses ln(X) and Y
- **Exponential**: uses X and ln(Y)
- **Power**: uses ln(X) and ln(Y)

In addition, the **correlation coefficient r** measures the closeness of the fit. The closer r is to 1 or –1 the better the fit. The closer r is to 0, the worse the fit.

Examples

Two-Variable Statistics: Your company has five sales offices around the world and is thinking of adding a sixth. The president of the company wants to know if there is a correlation between the number of salespersons at a branch and the volume of sales per month. What volume of sales can be expected at the new sixth branch if it has 10 sales people?

Site	Number Sales People	Sales per month ($)
1	8	200,000
2	13	237,250
3	15	397,500
4	18	427,590
5	12	242,820

Key	**Entry**	**Comments**
Clear…		Sets the display to its default values
Linear		Set the calculation method in the top, right-hand corner
$Stat_0$ – X	8	
$Stat_0$ – Y	200,000	
$Stat_1$– X	13	
$Stat_1$ – Y	237,250	
$Stat_2$– X	15	
$Stat_2$ – Y	397,500	
$Stat_3$ – X	18	
$Stat_3$ – Y	427,590	
$Stat_4$ – X	12	
$Stat_4$ – Y	242,820	

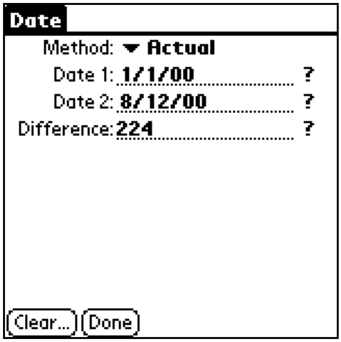
To calculate, select "?" on the top line of the computations. This must be done first. Then, enter 10 for X' and compute Y'. Sales can be expected to be approximately $219,916.79. The number of salespersons seems to affect revenue. This is known because the correlation coefficient (R) is 0.91 (the closer to 1 or –1 the better).

Calendar

Calendar computations in powerOne Graph include both date and time computations.

Date Calculations

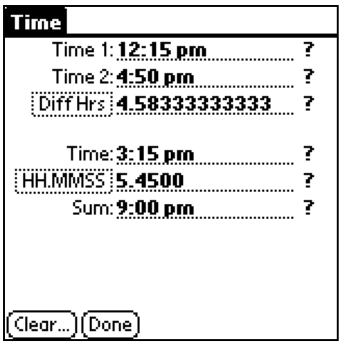
Dates can be computed using either the actual or 30/360 day-count method.



The actual date method assumes a standard calendar year. The 30/360 method assumes there are 30 days in a month and 360 days in a year.

- **Method**: the calculation method: actual or 30/360.
- **Date 1**: the date to compute from.
- **Date 2**: the date to compute to.
- **Difference**: the difference in number of days.

Time Calculations



The time worksheet performs both time difference and time summation calculations.

The top section performs time difference calculations:

- **Time 1**: beginning time.
- **Time 2**: ending time.
- **DiffHrs/Diff H.MM**: difference between the two times. DiffHrs displays as fraction of an hour.

Diff H.MM displays in hour-minute format (5 hrs, 45 minutes would display as 5.45).

The bottom section performs difference calculations:

- **Time**: one time amount to add.
- **HH.MMSS/Hrs.Frac**: second time to add. Hrs.Frac is entered as a fraction of an hour. HH.MMSS is entered in hour-minute-second format (4 hrs, 45 min, 30 sec is entered as 4.4530).
- **Sum**: sum of the two times.

Examples

Date: Go to the Calendar – Date worksheet to compute this problem. Vacation begins on October 15, 1999. Today is August 18, 1999. How many actual days until vacation?

Key	Entry	Comments
Clear…		Sets the display to its default values
Method	Actual	
Date 1	8/18/99	Enter August 18, 1999
Date 2	10/15/99	Enter October 15, 1999

Compute the difference in days by selecting "?" on the same line. There are 58 days until vacation.

Time Difference: Go to the Calendar – Time worksheet to compute this problem. When billing time, the project began at 12:15pm and concluded at 4:50pm. If you bill at $30 per hour, how much did you make?

Key	Entry	Comments
Clear…		Sets the display to its default values
Time 1	12:15 pm	
Time 2	4:50 pm	

Make sure Diff Hrs is showing instead of Diff H.MM. Compute the difference by selecting "?" on the same line. This project took 4.5833 hours (4 hours, 35 minutes). To finish the calculation, select the Diff Hrs value and multiply by 30. You made $137.50 for your work.

Time Sum: Go to the Calendar – Time worksheet to compute this problem. If you started driving at 3:15 pm and it took 5 hrs, 45 minutes to get to your destination, what time did you arrive?

Key	**Entry**	**Comments**
Clear…		Sets the display to its default values
Display	Standard	
Time	3:15 pm	
HH.MMSS	5:45	Make sure doesn’t show Hrs.Frac

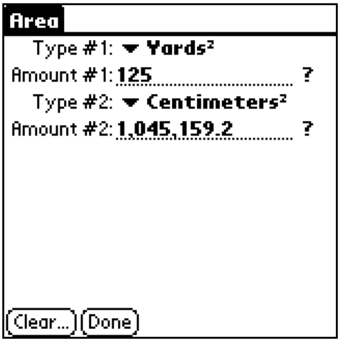
Compute the sum by selecting “?” on the same line. You arrived at 8:15pm.

Conversions

powerOne Graph handles eight kinds of unit conversions: **area**, **energy**, **length**, **mass**, **pressure**, **temperature**, **velocity** and **volume**.

Each screen appears the same with only a variation in the units to convert.

- **Type #1**: the unit type to convert from.
- **Amount #1**: the amount of the first type.
- **Type #2**: the unit type to convert to.
- **Amount #2**: the amount of the second type, calculated.



Examples

Length: Choose Length from the Convert worksheet category to compute this problem. The instructions say to measure off 25 meters but you don’t have a metric measure. How many feet is this?

Key	**Entry**	**Comments**
Clear…		Sets the display to its default values
Type #1	Meters	Choose from pop-up list
Amount #1	25	
Type #2	Feet	

Compute the amount of feet by selecting “?” on the Amount #2 line. There are 82.02 feet in 25 meters.

Business Computations

In powerOne Graph, a series of business computations exist. Included are worksheets to perform **markup**, **percent change**, **sales tax**, and **tip** computations.

Markup

This worksheet performs markup computations:

- **Method**: computation based on price or cost. Profit margin computations are based on price; percent change computations are based on cost.
- **Cost**: the cost to manufacture or purchase.
- **Price**: the selling or resale price.
- **Markup%**: the markup expressed as a percentage. For example, an 8.125% change would be entered as “8.125”. A positive value represents an increase while a negative one represents a decrease.

Percent Change

This worksheet performs percentage change computations with one or more compounding periods:

- **Old**: the old value.
- **New**: the new value.
- **Change%**: the percentage changed per period. For example, an 8.125% change would be entered as “8.125”. A positive value represents an increase while a negative one represents a decrease.
- **Periods**: the number of periods.

Sales Tax

The sales tax worksheet computes tax before or after sales tax, or the tax rate itself:

- **Before Tax**: the amount before taxes.
- **Tax Rate%**: the tax rate as a percentage.
- **After Tax**: the amount after taxes.

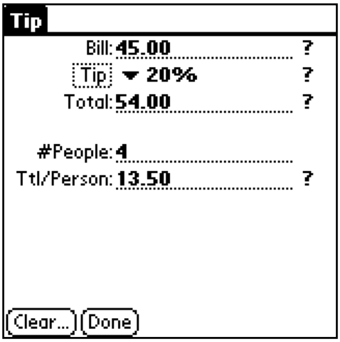
Discount

This worksheets performs discount computations:

- **Price**: current price.
- **Sales Price**: sales price.
- **Discount%**: percentage discount. For example, a 30% discount would be entered as “30”.

Tip

The tip calculator computes tip, total bills, and performs bill splitting functions:



- **Bill**: amount of the bill.
- **Tip/Tip%/Tip$**: tip amount or percentage. With Tip showing, a tip can be chosen from a pop-up list. With Tip% showing, a percentage can be entered (17.5% is entered as “17.5”). With Tip$ showing, a tip amount can be entered.
- **Total**: total amount including the bill.
- **#People**: number of people paying for the bill and tip.
- **Ttl/Person**: total per person.

Examples

Percent Change: To perform this computation, choose Percent Change from the Business category on the main calculator’s worksheet bar. Over 4 years, the price of gasoline increased from $1.03 to $1.48. What is the yearly change in price?

Key	Entry	Comments
Clear…		Sets the display to its default values
Old	1.03	
New	1.48	
Periods	4	

Compute the percent change by selecting "?" on the Change% line. The price of gasoline has increased 9.49% per year.

Sales Tax: To perform this computation, choose Sales Tax from the Business category on the main calculator's worksheet bar. The local tax rate is 5.5%. You have a maximum of $70 to spend on clothing. What is the maximum amount of clothing you can purchase and still have enough to pay for the tax?

Key	Entry	Comments
Clear…		Sets the display to its default values
Tax Rate%	5.5	
After Tax	70	

Compute the before tax amount by selecting "?" on the same line. You can have a maximum of $66.35 worth of clothing.

Discount: To perform this computation, choose Discount from the Business category on the main calculator's worksheet bar. The clothing is sold at a 25% discount. What is the current price if the original price is $29.99?

Key	Entry	Comments
Clear…		Sets the display to its default values
Method	Discount	
Orig Price	29.99	
Percent%	25	

Compute the price by selecting "?" on the same line. The selling price is $22.49.

Margin: To perform this computation, choose Markup from the Business category on the main calculator's worksheet bar. The clothing was bought for $19.99 and sold for $22.49. What is the profit margin percentage?

Key	Entry	Comments
Clear…		Sets the display to its default values
Method	Margin	
Orig Price	19.99	
New Price	22.49	

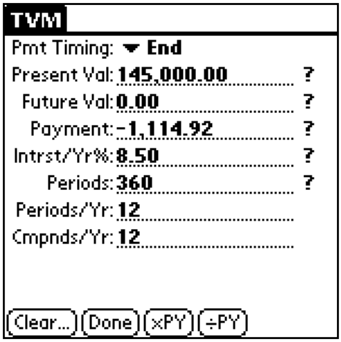
Compute the Percent% by selecting "?" on the same line. The profit margin is 11.126%.

Tip: To perform this computation, choose Tip from the Business category on the main calculator's worksheet bar. Four friends go to lunch. The bill totals $45 and the service was good – a 20% tip is in order. What is the total to be paid and the amount per person if split evenly?

Key	Entry	Comments
Clear…		Sets the display to its default values
Bill	45	
Tip	20	Choose from pop-up list
#People	4	

Compute the Total by selecting "?" on the same line. The total bill is $54. The split calculates automatically and equals $13.50 per person.

Time Value of Money (TVM)



Time value of money is the process of earning compound interest over a period of time. Compound interest problems assume that the interest earned also earns interest. Computations such as loans, leases, mortgages, annuities, and savings accounts are compound interest problems.

In Time value problems, positive and negative numbers have different meanings: positive numbers are inflows of cash (cash received) while negative numbers are outflows (cash paid). A car loan, for instance, may have a positive present value (because money was received from the loan company) but will have a negative payment amount, since this is money that will be paid back to the loan company.

The Display

The TVM display includes a series of variables and buttons:

- **Pmt Timing**: the payment timing. Payments occur at the beginning or end of the period. Payments made at the beginning of the period are called **Annuity Due**. Most leases are this kind. A payment made at the end of the period is called an **Ordinary Annuity**. Most loans are this kind.
- **Present Val**: the present value.
- **Future Val**: the future value.
- **Payment**: payment amount per period.
- **Intrst/Yr%**: interest per year as a percentage. For example, 8.25% interest should be entered as "8.25".
- **Periods**: number of total periods. This number is the number of years and months times the periods per year. For example, if the loan is 4 years with 12 payments per year (monthly payments), periods should be 48 (4 x 12).

- **Periods/Yr**: the number of payment periods per year. For example, if payments are made quarterly, periods per year should be 4.
- **Cmpnds/Yr**: the number of interest compounding periods per year. Most of the time, compounding periods per year should equal payment periods per year. For example, if interest is compounded monthly, compounding periods per year should be 12.

Additionally, there are two buttons on the screen next to the Done button:
- **xPY**: quick set button for the number of periods. This button multiplies the value in periods by the value in periods per year. For example, to convert 10 years at 12 periods per year to periods, enter 10 in periods, 12 in periods per year, and select xPY.
- **÷PY**: quick set button for the number of periods. This button divides the value in periods by the value in periods per year. For example, if periods is 60 with periods per year equal to 12, discovering that is five years can be done easily by selecting ÷PY.

Examples

Car Loan: When purchasing a new car, the auto dealer has offered a 12.5% interest rate over 36 months on a $7,500 loan. What will be the monthly payment?

Key	Entry	Comments
Clear…		Sets the display to its default values
Pmt Timing	End	Loan payments are at the end of the period
Present Val	7500	
Intrst/Yr%	12.5	
Periods	36	3 years at 12 periods per year
Periods/Yr	12	
Cmpnds/Yr	12	

Compute payment by selecting “?” on the Payment line. The payment will be –250.90. It is negative because it is a cash outflow.

Retirement Annuity: With 35 years until retirement and $15,000 in the bank, it is time to think about savings. How much would have to be put aside at the beginning of each month to reach $2.5 million if an interest rate of 10% can be expected?

Key	Entry	Comments
Clear…		Sets the display to its default values
Pmt Timing	Begin	
Present Val	-15,000	Negative because cash out of hand
Future Val	2,500,000	Positive because future cash inflow
Intrst/Yr%	10.0	
Periods	420	35 years x 12 periods per year
Periods/Yr	12	
Cmpnds/Yr	12	

Compute by selecting "?" next to Payment. The payment amount is –525.15. It is negative because it is a cash outflow.

Savings Account: With $3,000 in a savings account and 3.75% interest, how many months does it take to reach $4,000?

Key	Entry	Comments
Clear…		Sets the display to its default values
Pmt Timing	End	
Present Val	-3,000	Negative because cash deposit to open account
Future Val	4,000	
Payment	0	
Intrst/Yr%	3.75	
Periods/Yr	12	
Cmpnds/Yr	12	

Compute periods by selecting "?" on the same line. To reach $4,000, it will take 92.20 periods (or 92.20 ÷ 12 = 7.68 years).

Home Mortgage: You have decided to buy a house but you only have $900 to spend each month on a 30-year mortgage. The bank has quoted an interest rate of 8.75%. What is the maximum purchase price you can afford?

Key	Entry	Comments
Clear…		Sets the display to its default values
Pmt Timing	End	Loans payments at the end of the period
Future Val	0	
Payment	-900	Negative because cash outflow
Intrst/Yr%	8.75	
Periods	360	30 years at 12 periods per year
Periods/Yr	12	
Cmpnds/Yr	12	

Compute present value by selecting "?" on the same line. You can afford a home with a price of $114,401.87.

Mortgage With Balloon Payment: (Continued from Home Mortgage) You realize that you will only own the house for about 5 years and then sell it. How much will the balloon payment (the repayment to the bank) be?

Key	Entry	Comments
Periods	60	5 years at 12 periods per year

Compute future value by selecting "?" on the same line. The balloon payment will be $109,469.92 after five years.

Canadian Mortgage: Canadian mortgages compound interest twice per year instead of monthly. What is the monthly payment to fully amortize a 30-year, $80,000 Canadian mortgage if the interest rate is 12%?

Key	Entry	Comments
Clear…		Sets the display to its default values
Pmt Timing	End	Loans payments at the end of the period
Present Val	80,000	
Future Val	0	
Intrst/Yr%	12.00	
Periods	360	30 years at 12 periods per year
Periods/Yr	12	
Cmpnds/Yr	2	

Compute payment by selecting "?" on the same line. The payment will be –$805.11.

Bi-Weekly Mortgage Payments: A buyer is considering a $100,000 home loan with monthly payments, an annual interest rate of 9% and a term of 30 years. Instead of making monthly payments, the buyer realizes that he can build equity faster by making bi-weekly payments (every two weeks). How long will it take to pay off the loan?

Part 1: Calculate the monthly payment

Key	Entry	Comments
Clear…		Sets the display to its default values
Pmt Timing	End	
Present Val	100,000	
Future Val	0	
Intrst/Yr%	9.00	
Periods	360	30 years at 12 periods per year
Periods/Yr	12	
Cmpnds/Yr	12	

Calculating shows payment equal to –$804.62.

Part 2: Periods when making bi-weekly payments (continued)

Key	Entry	Comments
Payment	-402.31	Recall payment in the input screen and divide it by 2

Periods/Yr	26	Bi-weekly payments mean 26 per year
Cmpnds/Yr	12	Still compounding interest monthly

Calculating shows periods equal to 567.40 periods (567.40 ÷ 26 = 21.82 years).

APR of a Loan with Fees: The Annual Percentage Rate (APR) is the interest rate when fees are included with the mortgage amount. Because the fees reduce the loan amount, the interest rate is higher. For example, a borrower is charged two points for the issuance of a mortgage (one point is equal to 1% of the mortgage amount). If the mortgage amount is $60,000 for 30 years with an interest rate of 11.5%, what is the APR?

Part 1: Calculate the actual monthly payment

Key	**Entry**	**Comments**
Clear…		Sets the display to its default values
Pmt Timing	End	
Present Val	60,000	
Future Val	0	
Intrst/Yr%	11.5	
Periods	360	30 years at 12 periods per year
Periods/Yr	12	
Cmpnds/Yr	12	

Calculating shows payment equal to –$594.17.

Part 2: Periods when making bi-weekly payments (continued)

Key	**Entry**	**Comments**
Present Val	58,800	The loan amount less 2% in fees. Calculate in the input screen with 60,000 [–] 2 [%x] [=]

Calculating shows interest per year equal to 11.76%.

Present Value of Lease with Advance Payments and an Option to Buy: With a lease, often there is an amount to be paid up-front and an option to buy at the back-end. A company is leasing a machine for 4 years. Monthly payments are $2,400; an additional $2,400 payment at the beginning of the leasing period replaces the final payment. The leasing agreement includes an option to buy the machine for $15,000 at the end of the leasing period. What is the capitalized value of the lease, assuming that the interest rate paid to borrow the funds is 18% compounded monthly?

Part 1: Find the present value of the payments

Key	Entry	Comments
Clear…		Sets the display to its default values
Pmt Timing	Beg	
Future Val	0	
Payment	–2,400	
Intrst/Yr%	18.00	
Periods	47	4 years at 12 per year less 1 advance payment
Periods/Yr	12	
Cmpnds/Yr	12	

Calculating shows present value equal to $81,735.58. Select this value to pop-up the input screen and save the value to memory location 0.

Part 2: Present Value of the buy option (continued)

Key	Entry	Comments
Future Val	–15,000	
Payment	0	
Periods	48	

Calculating shows present value equal to $7,340.43.

Part 3: Calculate (continued)
Recall the present value to the input screen. Add in present value of the payments stored at location 0 and $2,400 for the advanced payment. The answer is $91,476.00.

Creating Worksheets with the Solver

powerOne Graph makes it easy to create custom worksheets. The solver is the technology that can take a formula and calculate for any variable within that formula.

Quick Tutorial

Creating a worksheet is as simple as entering a name and formula. To get started, choose “New Worksheet” from the Solver category on the main calculator’s worksheet bar.

A formula for calculating inflation will be used to illustrate the steps in creating a worksheet

Step 1: Enter a Name

The first step is to enter a name and choose a category on the worksheet bar. All of the built-in categories appear in the list but you can also create a new category by choosing “Edit Categories…”. 9 custom categories can be created. They will appear after the built-in categories on the worksheet bar.

For the example, enter “Inflation” (without quotes) in the text field and choose the “Business” category from the category pop-up list.

Once completed, select the “Next” button.

Step 2: Enter the Equation

In the second step, you will go to a variation of the main calculator. In this display, the main calculator’s view window has changed to a text entry field with “Save”, “Cancel”, and “Details” buttons below it.

Enter your formula in the text entry field. The equals sign can go anywhere in the formula. To help with entry, the built-in keyboard

can be used. The Palm OS' built-in keyboard shows more lines of text and offers letter and number characters to speed entry (in more recent versions of the operating system, Graffiti characters can be entered as well). Access the keyboard by selecting either the letters or numbers in the lower left or right-hand corner of the Graffiti area. Read your device user's manual for more information on using the keyboard.

When entry is complete, tap "Save" to create the worksheet. "Cancel" throws away the changes made. "Details" allows easy access to change the name of the worksheet or add notes about the worksheet.

To return to the inflation example, its formula is as follows:

$$\text{FutureVal} = \frac{\text{PresentVal}}{\left(1 + \frac{\text{Inflation}}{100}\right)^{\text{Years}}}$$

To enter in powerOne Graph, type the following (without quotes):
"FutureVal = PresentVal / ((1 + Inflation/100) ^ Years)"

When completed, select the "Save" button to create the worksheet.

Step 3: Use the Worksheet

From this point on, the worksheet acts like all other worksheets in powerOne Graph. See the section on Using the Worksheets for more information on using and sharing your created worksheets.

To complete the example, the following problem can be solved:

Inflation: What is the purchasing power of $5,000 after 5 years if the inflation rate is 4%?

Key	**Entry**	**Comments**
Clear…		Clears the display
PresentVal	5000	
Inflation	4	
Years	5	

Compute by selecting "?" next to FutureVal. The future value is $4,109.64.

Equations

An equation is made of four components:

- **Variables**: the names of items that are either stored or calculated. Variable names must consist of letters (capital or lower case 'a' through 'z') and optionally, numbers (0 through 9), with a maximum of 31 characters. The variable name is case sensitive (i.e. abc is different from ABC) and it cannot start with a number. In the above inflation equation, FutureVal, PresentVal, Inflation and Years are all variables. powerOne Graph can handle any number of variables in any individual equation. Note that the percentage symbol (%) is a mathematical symbol and cannot be used in the name of a variable.
- **Constants**: these are values that do not change. In the above example, the number 1 is a constant. Do not use digit separators (such as commas or spaces). For decimal separators, use the setting defined in the system's Prefs view and indicated as the decimal separator button (either point or comma). Use the keypad to enter these.
- **Operators**: mathematical symbols such as +, –, *, /, etc.
- **Functions**: allows for more advanced mathematical capabilities, which are built into the calculator (e.g., cosine). Some functions are available via the function bar while others can only be entered with Graffiti strokes. For a definition of each available function, see the Function List section.

Additional notes on entering equations:

- The solver follows order of operations precedence. See the chart in the Appendix for more information. To override order of operations or in cases where order of operations is uncertain, use parentheses in the formula.
- Spaces are ignored. Often, when the equation is strung together on the screen without any spaces, it is difficult to read. Use spaces to help.
- There is no implied multiplication. If an equation shows "z (1 + h)", that needs to be entered as "z * (1 + h)".
- Often an either/or situation exists when performing a calculation. If statements are used to express these relationships. See its section in Solver Functions for more information.

Accessing Custom Worksheets

There are multiple methods for accessing custom worksheets. The first is to select it from the main calculator's worksheet bar like any other worksheet. The second is to use the "My Worksheets" list, available in the Solver category of the worksheet bar.

My Worksheets shows all custom worksheets created or imported into the powerOne Graph program and offers a central location to easily start a new worksheet, or open, edit, beam, export or delete existing worksheets. To start a new worksheet, select the "New" button at the bottom of the display. To work with an existing worksheet, select that worksheet and choose an option from the list:

- **Open**: starts the worksheet for calculation.
- **Edit**: puts the worksheet in edit mode by returning the equation to the equation entry view.
- **Beam**: beams the worksheet to another powerOne user.
- **Export**: exports the worksheet to the desktop.
- **Delete**: deletes the selected worksheet.

For more information on using, beaming and exporting worksheets, read the section on Using the Worksheets.

How the Solver Works

powerOne Graph uses an iterative solver to balance an equation and determine an answer, relying on a minimum and maximum guess to "bracket" the answer. An equation is said to be in balance when, tabulated, the value to the left of the equals sign is the same as the value to the right of the equals sign.

In its simplest form, iterative solvers determine a mid-point between a maximum and minimum guess and evaluates the equation at all three points. It then decides which two points the equation is between – the mid-point and minimum guess or mid-point and maximum guess – and calculates a new mid-point based on those two points. It continues this cycle until it "guesses" the right answer. While powerOne Graph's solver is more advanced than this, it is similar in nature.

When performing an iterative calculation, a Computing dialog appears. Guesses made by powerOne Graph flash on the screen. If the "Cancel" button is selected, the answer will return as the last guess.

To speed execution and increase the likelihood of an answer, change the max and min range settings in the Variable Preferences. In some cases, the solver can calculate an answer directly without iterating to an answer. In this case, max and min range settings are not available. For more on Variable Preferences, see its section in Using the Worksheets.

Examples

Constant Acceleration: What is the stopping distance for a car traveling 30 meters per second that is decelerating at 5 meters per second ^{2}? Use the following formula:

$$velocity_1^2 = velocity_0^2 + 2 * acceleration * distance$$

Enter the equation as follows:

Velocity1^2 = Velocity0^2 + 2 * Accelrtn * Distance

After entering the formula, select "Save" to start the worksheet.

Calculating the answer:

Key	**Entry**	**Comments**
Velocity1	0	Stopped at end of distance
Velocity0	30	30 m/s at start of distance
Accelrtn	-5	Slowing at 5 m/s^2

Compute the Distance by selecting "?" on its line. It will take 90 meters to stop.

Multiple Answers: For the following formula, x can be both a positive and negative answer when y is equal to 9. What are the two answers?

$$y = x^2 - 3$$

Enter the equation as follows:

y = x^2 - 3

After entering the formula, select "Save" to start the worksheet.

powerOne Graph will usually find the positive answer first. Enter 9 for y and calculate x. The answer will return as 3.46.

Next, go to Variable Preferences in the Options menu and change the Variable pop-up list to "x". Under Range, enter 0 for the maximum value. Recalculating x will give an answer of –3.46.

IF Statements: Many companies use profit sharing formulas as an incentive to boost pay and drive higher corporate net income. In this example, the following relationships are established for profit sharing:

- If net income is less than or equal to $1 million, there is no profit sharing.
- If net income is greater than $1 million but less than or equal to $5 million, profit sharing is 2% of monthly pay.
- If net income is greater than $5 million, profit sharing is 4% of monthly pay.

If your monthly base pay is $3000, what is your net pay with profit sharing?

Enter the equation as follows:

NetPay = BasePay + if(NetIncome <= 1000000; 0; if(NetIncome > 1000000 && NetIncome <= 5000000; BasePay * .02; BasePay * .04))

To break down the formula:

- There are two if statements, the second "nested" inside the first.
- The format for if statements is if(conditional true; do this; otherwise do this).
- The first if statement says if net income is less than or equal to (<=) 1,000,000, add 0 otherwise do the second if statement.
- The second if statement says if net income is greater than (>) 1,000,000 and (&&) net income is less than or equal to (<=) $5,000,000, then add in 2% of the base pay. If it doesn't meet this condition, than net income must be larger since we took care of all other conditions. Add in 4% of base pay instead.
- Note that nested if statements read from left to right. If the first criteria is true, powerOne Graph will not continue to the false statement. Because of that, the formula could be written as: NetPay = BasePay + if(NetIncome <= 1000000; 0; if(NetIncome <= 5000000; BasePay * .02; BasePay * .04)) leaving out "NetIncome > 1000000 &&" in the second, nested if statement.

After entering the formula, select "Save" to start the worksheet.

Calculating answers:

- Enter 3000 for BasePay.
- Example 1: enter 0 for NetIncome and calculate NetPay. Your net pay is the same as your base pay, $3,000.

- Example 2: enter 2,000,000 for NetIncome and calculate NetPay. Your net pay would be $3,060.
- Example 3: enter $10,000,000 for NetIncome and calculate NetPay. Your net pay would be $3,120.

Function List

This section lists all functions available within the solver or in the entry field. To read, the top line in bold lists both the function by name and its symbol (if applicable). The second line lists the function and its variables, followed in the third line by a detailed function description. Within the formula, items in brackets [ ] are optional entries.

A function that accepts a value may generally take a structure (list, table, vector, or matrix) instead. In this case, the function will operate individually on each value within the structure. (e.g., abs(*tableA*) will return a table with the same dimensions as *tableA*, with each element equal to the absolute value of the corresponding element of *tableA*.)

A function that accepts two values may generally take two structures of equal size, and will then return a structure of that size. Each element of the returned structure will be the result of the operation performed on the corresponding pair of input values. (e.g., *tableA* + *tableB* will return a table of the same size as *tableA* and *tableB*, with each element equal to the sum of the corresponding elements of *tableA* and *tableB*.) If the two structures are not the same size, an array size error will occur. The structures must also be of the same type (i.e. tables, lists, matrices or vectors).

A function that accepts two values may also be passed a structure and an individual value, and will then return a structure of the same size as the input structure with each element being the result of the operation performed on the corresponding structure element and the individual value. (e.g., *tableA* / 3 will return a table of the same size as *tableA*, with each element equal to the corresponding element of tableA divided by 3. 3 / *tableA* is also valid, and will return 3 divided by each element of *tableA*.)

A table may contain any type of data, including complex, dates, and strings. A matrix can only contain boolean, integer, or double values. Certain mathematical operations have special significance for

matrices, and give different results for matrix inputs than for table inputs. (e.g., *tableA* * *tableB* simply returns a table of multiplication results, while *matrixA* * *matrixB* performs the matrix product operation.) If there is no special matrix behavior defined for a particular function, a matrix will by default be treated like a table.

Mathematics Functions

Absolute Value (abs)

abs(*valueA*)
Returns absolute value of *valueA*.
Returns polar coordinate r given a complex value or table.
abs(x; y)
Returns polar coordinate r given rectangular coordinates *x, y*.

Addition (+):

valueA + *valueB*
Returns *valueA* plus *valueB*.

Append

append(*valueA*; *valueB*) :
Horizontally concatenates two structures provided they have the same number of rows. *valueA* and *valueB* must be the same data type.

Augment

augment*(valueA; valueB)* :
Vertically concatenates two structures provided they have the same number of columns. *valueA* and *valueB* must be the same data types.

Cast to Boolean (→Bool)

tobool(*value*) :
Returns a boolean by casting *value* to a boolean value.

Cast to Double (→Double)

tofloat(*value*) :

Returns a float by casting *value* to a double.

Cast to Fraction

Value →frac:

Returns *value* as a fraction.

Cast to Integer (→I32)

toint(*value*) :

Returns an integer by casting *value* to a signed 32 bit integer.

Cast to Mixed Fraction

Value →mFrac:

Returns *value* as a mixed fraction.

Ceiling (ceil)

ceil(*value*)

Returns the smallest integer ≥ *value*. i.e. ceil(4.5) ⇒ 5, ceil(– 4.5) ⇒ – 4

Cube Root ($\sqrt[3]{}$):

cbrt(*value)*

Returns the cube root of *value*.

Division (÷)

valueA / *valueB*

Returns *valueA* divided by *valueB*.

Exponent (EE)

value E *exponent*

Used to make *value* times 10 raised to *exponent* where *exponent* is an integer (whole number).

$value*10^{exponent}$ must lie between -1E308 and 1E308 inclusive.

Exponential (e^)

exp(*value)*

Returns e raised to the *value* power.

Floor (floor)

floor(*value*)

Returns the largest integer ≤ *value*. i.e. floor(4.5) ⇒ 4, floor(–4.5) ⇒ –5

Fractional Part (fpart)

fpart(*value*)

Returns fractional part of *value*. i.e. fpart(4.5) ⇒ 0.5, fpart(– 4.5) ⇒ – 0.5, fpart(1) ⇒ 0.0

Greatest Common Denominator (gcd)

gcd(*valueA*; *valueB*)

Returns the greatest common divisor of *valueA* and *valueB*, where $-2^{31} <= valueA, valueB < 2^{31}$.

Integer Part (ipart)

ipart(*value*)

Returns integer (whole number) part of *value*. i.e. iPart(4.5) ⇒ 4, iPart(– 4.5) ⇒ – 4

Inverse (x^{-1})

value ^ –1

Returns *value* raised to –1.

Least Common Multiple (lcm)

lcm(*valueA*; *valueB*)

Returns the least common multiple of *valueA* and *valueB*, where $-2^{31} <= valueA, valueB < 2^{31}$

Logarithm (log)

log(*value)*

Returns the base 10 logarithm of *value*.

Maximum (max)

max(*valueA* [; *valueB*; ...])

Returns the larger of *valueA* and *valueB*.

Minimum (min)

min(*valueA* [; *valueB*; ...])

Returns the smaller of *valueA* and *valueB*.

Modulo Division (mod)

mod(*valueA*;*valueB*)

Returns remainder of *valueA* divided by *valueB*.

Multiplication (x)

valueA * *valueB*

Returns *valueA* times *valueB*.

Natural Logarithm (ln)

ln(*value)*

Returns the natural logarithm of *value*.

Percent (%)

valueA %	Returns *valueA* / 100
valueA + *valueB* %	Returns *valueA* + *valueA* * *valueB* / 100
valueA – *valueB* %	Returns *valueA* – *valueA* * *valueB* / 100
valueA * *valueB* %	Returns *valueA* * *valueB* / 100
valueA / *valueB* %	Returns *valueA* / *valueB* / 100

Power (y^x)

valueA ^ *valueB*

Returns *valueA* raised to *valueB*.

Product

prod(*list*)

Returns the product of elements in *list*. *list* may be a table or matrix of integer, double or complex data types.

Reciprocal (1/x)

1 / *value*
Returns 1 divided by *value*.

Root ($^x\sqrt{}$)

root(*y*; *x*)
Returns *x* th root of *y*.

Round to Nearest (round)

round(*valueA*[; *#decimals*])
Returns *valueA* rounded to *#decimals*, where *#decimals* may be a whole number that fulfills 0 <= *#decimals* <= 10. The default value for *#decimals* is 0.
e.g. round(4.05;1) ⇒ 4.1, round (4.049;1) ⇒ 4.0

Sequence (seq)

seq(*expression*; *variable*; *begin*; *end* [; *increment*]))
Returns list created by evaluating *expression* with regard to *variable* from *begin* to *end* by *increment*. Default value for *increment* is 1.
expression and *variable* are both strings, *begin*, *end* and *increment* may be integers or doubles.
Note that the sign of the increment value must correspond to the range represented by *begin*, *end*; i.e. if *begin*>*end, increment* must be negative. If there are not an exact number of increments in the range then the last value calculated will be just before the end value; eg seq("a^2";"a";1;11;3) yields the same result as seq("a^2";"a";1;10;3)

Sigma (Σ)

sigma(*expression*; *variable*; *begin*; *end* [; *increment*]))
Returns sum of values created by evaluating *expression* with regard to *variable* from *begin* to *end* by *increment*. Default value

for *increment* is 1.
expression and *variable* are both strings while *begin*, *end* and *increment* are numbers.
Note that the sign of the increment value must correspond to the range represented by *begin*, *end*; i.e. if *begin* > *end, increment* must be negative. If there are not an exact number of increments in the range then the last value calculated will be just before the end value; eg. sigma("a^2"; "a"; 1; 11; 3) yields the same result as sigma("a^2"; "a"; 1; 10; 3) (= 1^2 + 4^2 + 7^2 + 10^2 or 166).

Sign
sign(*value*)
Returns –1 if *value* is less than 0, 0 if *value* is 0, or 1 otherwise.

Square Root (√)
sqrt(*value*)
Returns the square root of *value*.

Subtraction (–)
valueA – valueB
Returns *valueA* minus *valueB.*

Summation (sum)
sum(*list*)
Returns the sum of elements in *list*. *list* may be a table or matrix of integer, double or complex data types.

Solve Functions

The solver uses a non-symbolic iterative approach to solve expressions for a particular variable. Because the method is iterative it can take a significant amount of time to complete and may fail to return a result or return a result that is inexact but within the tolerance permitted when using floating point math. The following forms are available:

solve(*expression*; *variable*)

Returns a value for *variable* that causes *expression* to be correct. *expression* and *variable* are both strings.
The algorithm will use default minimum and maximum bracket values of –1E300 and 1E300 respectively.
e.g. solve("x^2"; "x")

solve(*expression*; *variable*; *guess*)
Returns the value for *variable* that is close to guess and causes *expression* to be correct. *expression* and *variable* are both strings, *guess* may be an integer or double and is used to help steer the solver towards a particular solution.
The algorithm will use default minimum and maximum bracket values of –1E300 and 1E300 respectively.
e.g solve("x^2"; "x"; 3)

solve(*expression*; *variable*; *lower*; *upper*)
Returns the value for *variable* that lies between *lower* and *upper* and causes *expression* to be correct. *expression* and *variable* are both strings, *lower* and *upper* may be integers or doubles.
e.g. solve("x^2"; "x"; -2; 5)

Trigonometric Functions

Arc-cosine ($\cos^{-1}$)

acos(*value*)
Returns arc-cosine of *value*.

Arc-sine ($\sin^{-1}$)

asin(*value*)
Returns arc-sine of *value*.

Arc-tangent ($\tan^{-1}$)

atan(*value*)
Returns arc-tangent of *value*.

Cosine

cos(*value*)
Returns cosine of *value*.

Degrees to DMS Conversion

dms(*value*)

Returns equivalent in dd.mmss (degrees, minutes, seconds) of *value* degrees.

Degrees to Radians Conversion

radians(*value*)

Returns equivalent in radians of *value* degrees.

DMS to Degrees Conversion

degs(*value*)

Returns equivalent in degrees of *value* dd.mmss (ie degrees, minutes, seconds format).

Hyperbolic Arc-cosine ($\cosh^{-1}$)

acosh(*value*)

Returns hyperbolic arc-cosine of *value*.

Hyperbolic Arc-sine ($\sinh^{-1}$)

asinh(*value*)

Returns hyperbolic arc-sine of *value*.

Hyperbolic Arc-tangent ($\tanh^{-1}$)

atanh(*value*)

Returns hyperbolic arc-tangent of *value*.

Hyperbolic Cosine (cosh)

cosh(*value*)

Returns hyperbolic cosine of *value*.

Hyperbolic Sine (sinh)

sinh(*value*)

Returns hyperbolic sine of *value*.

Hyperbolic Tangent (tanh)

tanh(*value*)

Returns hyperbolic tangent of *value*.

Polar to Rectangular Conversion (y)

imag(*r*; *θ*)

Returns double containing the y coordinate given polar coordinates *r* and *θ*.

Polar to Rectangular Conversion (x)

real(*r*; *θ*)

Returns the x coordinate given polar coordinates *r* and *θ*.

Radians to Degrees Conversion

degrees(*value*)

Returns equivalent in degrees of *value* radians.

Rectangular to Polar Conversion (r)

abs(*x; y*)

Returns polar coordinate r given rectangular coordinates *x* and *y*.

Rectangular to Polar Conversion (θ)

angle(*x*; *y*)

Returns polar coordinate θ given rectangular coordinates *x* and *y*.

Sine

sin(*value*)

Returns sine of *value*.

Tangent

tan(*value*)

Returns tangent of *value*.

Complex Number Functions

Angle

angle(*value*)

Returns the polar angle of a complex number or table.

Cast to Polar (→Polar)

topolar(*value*)

Returns a complex number in polar format by casting *value* to a complex number in polar format.

Cast to Rectangular (→Rect)

torect(*value*)

Returns a complex number in rectangular format by casting *value* to a complex number in rectangular format.

Conjugate (conj)

conj(*valueA*)

Returns complex conjugate of a complex number or table of complex numbers.

Imaginary Part

imag(*valueA*)

Returns imaginary part of a complex number or table of complex numbers.

Real Part

real(*valueA*)

Returns real part of a complex number or table.

Theta

theta(*value*)

theta(*x*; *y*)

This function is the same as the Angle function.

Calculus Functions

Derivative (d/dx)

nderiv(*expression*; *variable*; *value* [; ε])
Returns an approximate numerical derivative of *expression* with respect to *variable* at *value* with optional specified tolerance ε (default value 10^{-5}).
e.g. nderiv("x^2"; "x"; 3) calculates the gradient of the curve x^2 at the point where x = 3.

Integral (∫)

fnint (*expression*; *variable*; *lower*; *upper*)
Uses numerical integration (Gauss-Kronrod) to return the integral of *expression* with respect to *variable* between *lower* and *upper* limits. The default value for optional parameter *stepsize* is 1/20 of the range between *lower* and *upper*. Note that making stepsize small relative to the range increases accuracy, but also the time taken to perform the integration.
e.g. fnint("x^2"; "x"; –3; 3) calculates the area bounded by the curve x^2 and the x axis between the limits x = –3 and x = 3.

Maximum (fMax)

fmax(*expression*; *variable*; *lower*; *upper* [; *tolerance*])
Uses an iterative approach to return the value of *variable* where the local maximum of *expression* occurs, between *lower* and *upper* limits, with optional *tolerance* (default value 10^{-5}).
e.g. fmax("-x^2"; "x"; –3; 3) searches for a maximum of the expression $–x^2$ between the limits x = –3 and x = 3.

Minimum (fMin)

fmin(*expression*; *variable*; *lower*; *upper* [; *tolerance*])
Uses an iterative approach to return the value of *variable* where the local minimum of *expression* occurs, between *lower* and *upper* limits, with optional *tolerance* (default value 10^{-5}).
e.g. fmin("x^2"; "x"; –3; 3) searches for a minimum of the expression x^2 between the limits x = –3 and x = 3.

Statistics Functions

Once one statistic is calculated, all others can be derived without passing a new set of data. The following items are stored when one is calculated:

μ	- mean
m	- median
n	- number of data points
σ_{n-1}	- sample standard deviation
σ_{n-1}^2	- sample variance
σ_n	- population standard deviation
σ_n^2	- population variance
Σx	- sum of x
Σx^2	- sum of the squares of x

Mean (μ)

Mean([*datalist* [; *freqlist*]])

Returns double containing the mean of *datalist* with optional frequency list *freqlist*.

If the arguments *datalist* & *freqlist* are absent, then the mean of the last data set used in a statistics operation is returned.

Note:

1) *datalist* and *freqlist* must both be tables or both be matrices and must have the same dimensions.

2) *datalist* and *freqlist* must only contain integer or double types and *freqlist* must contain positive integer values.

Median

Median([*datalist* [; *freqlist*]])

Returns double containing the median of list *datalist* with optional frequency list *freqlist*.

If the arguments *datalist* & *freqlist* are absent, then the median of the last data set used in a statistics operation is returned.

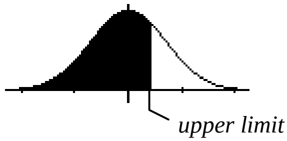
Note:

1) *datalist* and *freqlist* must both be tables or both be matrices and must have the same dimensions.

2) *datalist* and *freqlist* must only contain integer or double types and *freqlist* must contain positive integer values.

Normal S-Distribution, Standard Cumulative

normsdist(*upperlimit*)
Returns area under the standard normal distribution curve ($\mu = 0$, $\sigma = 1$) bounded by an upper limit of *upperlimit*.



Occurrences (*n*)

countx([*datalist* [; *freqlist*]])
Returns double containing the total number of data points contained in list *datalist* with optional frequency list *freqlist*.
If the arguments *datalist* & *freqlist* are absent, then the total for the last data set used in a statistics operation is returned.
Note:
1) *datalist* and *freqlist* must both be tables or both be matrices and must have the same dimensions.
2) *datalist* and *freqlist* must only contain integer or double types and *freqlist* must contain positive integer values.

Sum X (Σx)

sumx([*datalist* [; *freqlist*]])
Returns double containing the sum of data points contained in list *datalist* with optional frequency list *freqlist*.
If the arguments *datalist* & *freqlist* are absent, then the sum for the last data set used in a statistics operation is returned.
Note:
1) *datalist* and *freqlist* must both be tables or both be matrices and must have the same dimensions.
2) *datalist* and *freqlist* must only contain integer or double types and *freqlist* must contain positive integer values.

Sum X-Squared (Σx^2)

sumx2([*datalist* [; *freqlist*]])
Returns double containing the sum of the square of the data points contained in list *datalist* with optional frequency list *freqlist*.

If the arguments *datalist* & *freqlist* are absent, then the sum for the last data set used in a statistics operation is returned.
Note:
1) *datalist* and *freqlist* must both be tables or both be matrices and must have the same dimensions.
2) *datalist* and *freqlist* must only contain integer or double types and *freqlist* must contain positive integer values.

Standard Deviation, Population (σ_n)

stddevp([*datalist* [; *freqlist*]])
Returns double containing the population standard deviation of list *datalist* with optional frequency list *freqlist*.
If the arguments *datalist* & *freqlist* are absent, then the population standard deviation of the last data set used in a statistics operation is returned.
Note:
1) *datalist* and *freqlist* must both be tables or both be matrices and must have the same dimensions.
2) *datalist* and *freqlist* must only contain integer or double types and *freqlist* must contain positive integer values.

Standard Deviation, Sample (σ_{n-1})

stddev([*datalist* [; *freqlist*]])
Returns double containing the sample standard deviation of list *datalist* with optional frequency list *freqlist*.
If the arguments *datalist* & *freqlist* are absent, then the sample standard deviation of the last data set used in a statistics operation is returned.
Note:
1) *datalist* and *freqlist* must both be tables or both be matrices and must have the same dimensions.
2) *datalist* and *freqlist* must only contain integer or double types and *freqlist* must contain positive integer values.

Variance, Population (σ_n^2)

varp([*datalist* [; *freqlist*]])
Returns double containing the population variance of list *datalist*

with optional frequency list *freqlist*.
If the arguments *datalist* & *freqlist* are absent, then the population variance of the last data set used in a statistics operation is returned.
Note:
1) *datalist* and *freqlist* must both be tables or both be matrices and must have the same dimensions.
2) *datalist* and *freqlist* must only contain integer or double types and *freqlist* must contain positive integer values.

Variance, Sample (σ_{n-1}^2)

var([*datalist* [; *freqlist*]])
Returns double containing the sample variance of list *datalist* with optional frequency list *freqlist*.
If the arguments *datalist* & *freqlist* are absent, then the sample variance of the last data set used in a statistics operation is returned.
Note:
1) *datalist* and *freqlist* must both be tables or both be matrices and must have the same dimensions.
2) *datalist* and *freqlist* must only contain integer or double types and *freqlist* must contain positive integer values.

Probability Functions

Combinations (nCr)

ncr(*n*; *r*)
Returns the number of combinations of *n* taken *r* at a time.
n, *r* must be integer values where $0 \leq n, r \leq 170$. Returned values correspond to n!/(r!(n-r)!)

Factorial (!)

fact(*value*)
Returns factorial of *value*,
where $-169 <$ *value* ≤ 170, and *value* cannot be a negative integer value, but it can be a negative non-integer or any positive value.

Permutations (nPr)

npr(*n*; *r*)

Returns the number of permutations of *n* taken *r* at a time.

n, *r* must be integer values where $0 \leq n, r \leq 170$. Returned values correspond to n!/(n-r)!

Random Integer (randInt)

randint(*lower*; *upper* [; *numtrials*])

Returns a random integer (whole number) within a range specified by *lower* and *upper* integer bound. If *numtrials* is specified and is greater than 1, returns list of *numtrials* random numbers. If *numtrials* is absent, returns single random number.

Random Number (rand)

rand([*numtrials*])

Returns a random real number between 0 and 1. If *numtrials* is specified and is greater than 1 returns list of *numtrials* random numbers. If *numtrials* is absent, returns single random number.

Random Table (randT)

randt(*rows*; *columns*)

Returns a table of *rows* and *columns* with each element being a random double between 0 and 1.

Random Table of Integers (randTInt)

randtint(*rows*; *columns*; *lower*; *upper*)

Returns a random table of *rows* and *columns* with each element a random integer within the range specified by *lower* and *upper* integer bounds.

Date Functions

See Worksheet Preferences for setting the date mode. Date type is used within the calculator to represent a date. While it cannot be seen

in a worksheet, it can be used when calculating values that can be seen in a worksheet. When entering dates, there are two formats:

- Date dd.mmyyyy: 2 digit day, 2 digit month, 4 digit year
- Time hh.mmssmmm: 2 digits each for hour, minutes, second, and 3 digits for millisecond. Hour is entered in military time (0-23 hours).

Adjust Date

adjdate(*date*; *days* [; *months*; *years*])
This function can only be used within a formula – the returned value cannot be viewed in a worksheet. Returns a date type containing *date* plus (or minus) *days*, *months*, *years*.
date is a date type or a double containing the date in dd.mmyyyy format.

Adjust Time

adjtime(*date*; *hours* [; *minutes*; *seconds*])
This function can only be used within a formula – the returned value cannot be viewed in a worksheet. Returns a date type containing *date* plus (or minus) *hours*, *minutes*, *seconds*.
date is a date type, or a value in dd.mmyyyy format.

Date in Absolute Format (date)

makedate(*dd.mmyyyy* [; *hh.mmssmmm*])
This function can only be used within a formula or on the command line – the returned value cannot be viewed in a worksheet. Converts a date (and time) into a date type representing the inputted date. Provided for compatibility with TI, HP.

Day of Week (weekday)

wkday(*date*)
Returns a number representing the day of the week (1 = Sunday, 7 = Saturday). *Date* must be a date type or a value in dd.mmyyyy format.

Difference Between Dates (ΔDate)

ddays(*date1*; *date2*)

date1, *date2* must be a date type or a value in dd.mmyyyy format. Returns a number representing the number of days between two dates.

Get Date in Decimal Format (GetDate)

getdate(*date*)

Returns the date in dd.mmyyyy format given date type date.

Get Hours in Decimal Format (HRS)

hrs(*value*)

Returns the time in decimal hours given a date type or time in hh.mmssmmm format (3.5 decimal hours is 3 hrs, 30 min).

Get Hours in HH.MMSS Format (HMS)

hms(*value*)

Returns the time in hh.mmssmmm format given a date type or the time in decimal hours (3.5 decimal hours is 3 hrs, 30 min).

Get Time in Decimal Format (GetTime)

gettime(*date*)

This function can only be used within a formula – the returned value cannot be viewed in a worksheet. Returns the time in the format hh.mmssmmm given date type *date*.

Today (date)

today()

This function can only be used within a formula or on the command line – the returned value cannot be viewed in a worksheet. Returns a date type representing current date and time.

Logic Functions

And

valueA && valueB

Returns true if both *valueA* and *valueB* ≠ false.

Choose

choose(*index*; *expression1*; *...expressionN*)

Uses *index* to pick one of the expressions following *index* then returns the value of the picked expression. *index* can be an integer or double type or an expression that evaluates to an integer or double type, where 1 ≤ index ≤ number of expressions supplied. e.g. choose(2;6;9;3;4;5) returns 9.

Equals (=)

valueA == *valueB*

Returns true if *valueA* has equal value to *valueB*. Note that this operator is entered using two consecutive "=" characters, not a single "=" character. The single "=" is only used when entering worksheet or graphing equations.

Exclusive Or (xor)

valueA ## *valueB*

Returns true if either but not both of *valueA* and *valueB* ≠ false.

Greater Than (>)

valueA > *valueB*

Returns true if *valueA* > *valueB*.

Greater Than or Equal To (≥)

valueA >= *valueB*

Returns true if *valueA* ≥ *valueB*.

If (boolean?doiftrue:doiffalse)

if(*boolean*; *expressionA*; *expressionB*)

If *boolean* is true, evaluate *expressionA*, otherwise evaluate

expressionB.
e.g. if(A<0;sqrt(-A);sqrt(A)) returns the square root of the absolute value of A.

Less Than (<)

valueA < *valueB*
Returns true if valueA < valueB.

Less Than or Equal To (≤)

valueA <= *valueB*
Returns true if valueA ≤ valueB.

Not

! *valueA*
Returns false if value ≠ false.

Not Equal (≠)

valueA <> *valueB* -or- *valueA* != *valueB*
Returns true if *valueA* ≠ *valueB*.

Or

valueA || *valueB*
Returns true if valueA or valueB ≠ false.

Bitwise Operations

And

valueA & *valueB*
Returns integer, containing result of bitwise AND of *valueA* with *valueB*.

Cast to Binary

Value →b
Returns *value* as a binary integer.

Cast to Decimal

Value →d

Returns *value* as a decimal integer.

Cast to Hexadecimal

Value →h

Returns *value* as a hexadecimal integer.

Cast to Octal

Value →o

Returns *value* as an octal integer.

Exclusive Or (xor)

valueA # valueB

Returns integer, containing the result of bitwise XOR of valueA with valueB.

Not

~ *valueA*

Returns integer, containing bitwise NOT of valueA.

Or

valueA | valueB

Returns integer, containing result of bitwise OR of valueA with valueB.

Shift Left (<<)

valueA << *numbits*

Returns integer, containing result of shifting valueA to the left by numbits. If base units are not supplied the two numbers are treated as base 10 integers. Base units are:

b	binary
d	decimal
o	octal
h	hexadecimal

e.g. “10b<<Ah” shifts the binary number “10” left by ten places.

Shift Right (>>)

valueA >> numbits
Returns integer, containing result of shifting valueA to the right by numbits. Note that the MSB is the sign bit and is copied (not moved) to the next bit during this operation.
See “Shift Left” above for usage details.

String Manipulation

Get Substring (sub)

substr(*string*; *begin* [; *length*])
Returns the string with length given by optional parameter *length* that starts at position *begin* in *string*. If *length* is not supplied, then the returned string is the string that begins at position *begin* and ends with the end of *string*.

Length

length(*string*)
Returns the number of characters in *string*.

Search for Substring (inString)

instr(*string*; *substring* [;*start*])
Returns the character position in *string* of the first character in *substring* beginning the search at position given by optional parameter *start* (default starting position is the beginning of string). *string* and *substring* are strings, *start* may be an integer or double.

Data Structure Functions

Cast Matrix to Table (→Table)

totable(*value*)
Returns a table/list from a matrix/vector. *Value* is a matrix or

vector.

Cast Table to Matrix (→Matrix)

tomatrix(*value*)

Returns a matrix/vector from a table/list. *Value* is a table or list.

Create List

makelist(*value1*;... ;*valuen*)

Returns a list composed of *value1* through *valuen*.

Create Matrix

makematrix(*vector1*;... ; *vectorn*)

Returns a matrix using vectors *vector1* through *vectorn* Each vector becomes a row in the new matrix. The vectors must all be the same length.

Create Polar

makepolar(*r*; *θ*)

Returns a polar complex from doubles *r* and *θ*.

Create Rectangular

makerect(*x*; *y*)

Returns a rectangular complex from doubles *x* and *y*.

Create Table

maketable(*list1*; ...; *listn*)

Returns a table from lists *list1* through *listn*. Each list becomes a row in the new table. Each list must be the same length.

Cumulative Sum (cumSum)

cumsum(*value*)

Returns a list of the cumulative sums of the elements in the columns of *value*, starting with the first element.

Determinant (det)

det(*matrix*)

Returns a double containing the determinant of *matrix*.

Extract Single Element

getitem(*struct*; *row*; *column*)

Returns the element at *column* and *row* from *struct*.

getitem(list; *index*)

Returns the element at position *index* from *list*.

Extract Columns

getcol(*struct*; *column*)

Returns a list (or vector) containing the elements of *column* in *struct*.

getcol(*struct*; *column1*; *column2*)

Returns a table (or matrix if a matrix was passed in) containing the columns *column1* through *column2* from *struct*.

Extract Row

getrow(*struct*; *row*)

Returns a list (or vector) containing the elements of *row* in *struct*.

getrow(*struct*; *row1*; *row2*)

Returns a table (or matrix) containing the rows *row1* through *row2* from *struct*.

Fill Structure

fill(*struct*; *fillVal*)

Returns a matrix or table (depending on the data type of *struct*) with the dimensions of *struct* filled with *fillVal*, which may be a boolean, integer, or double for matrices, plus complex, date or string for tables.

Get Dimension (dim)

dim(*value*)

Returns a list of integers containing the dimension of a table or matrix when passed as *value*. Returns a single integer containing

the dimension of a list or vector when passed as *value*.

Identity Matrix

identity(*dimension*)

Returns the identity matrix of *dimension* rows×columns.

Re-dimension (redim)

redim(*value*; *length*)

Returns a list or vector (depending on the data type of *value*) containing data from *value*. *length* contains the size of the new list or vector.

redim(*value*; *row*; *col*)

Returns a matrix or table (depending on the data type of *value*) containing data from *value*. *row*, *col* are the number of rows and columns respectively for the new structure.

Row Addition (row+)

rowa(*matrix*; *row A*; *rowB*)

Returns a matrix with *rowA* of *matrix* added to *rowB* and stored in *rowB*.

Row-Echelon Form (ref)

ref(*matrix*)

Returns the row-echelon form of *matrix*.

Row-Echelon Form, Reduced

rref(*matrix*)

Returns the reduced row-echelon form of *matrix*.

Row Multiplication (*row)

rowm(*matrix*; *value*; *row*)

Returns a matrix with *row* of *matrix* multiplied by *value* and stored in *row*.

Row Multiply / Add Two (*row+)

rowma(*matrix*; *value*; *row A*; *rowB*)

Returns a table/matrix with *rowA* of *matrix* multiplied by *value,* added to *rowB* and stored in *rowB*.

Row Swap (rowSwap)

rowswap(*struct*; *row A*; *rowB*)
Returns a table/matrix with *rowA* swapped with *rowB*.

Sort Ascending

sorta(*struct*)
Sorts elements of *struct* in ascending order.

Sort Descending

sortd(*struct*)
Sorts elements of *struct* in descending order.

Sublist Extraction

sublist(*list*; *start*)
Returns a list containing a sublist of *list*, starting with element *start* and including all remaining elements *list*.
list is a list or vector, *start* is an integer.
sublist(*list*; *start*; *len*)
Returns a list containing a sublist of *list*, including *len* elements from *list* starting with element *start*.
list is a list or vector, *start* and *len* are integers.

Transform (matrix^T)

trans(*value*)
Returns a table/matrix in which each element (row, column) is swapped with the corresponding element (column, row). *Value* is either a table or matrix.

Appendix

The appendix contains additional information pertinent to the use of powerOne Graph.

Graffiti

powerOne Graph supports Graffiti entry for the input screen. To learn how to draw each character, see your handheld user manual.

Character	Function	Character	Function
0	Zero	<back> <space>	Backspace
1	One	c	C/CE
2	Two	+	Add
3	Three	–	Subtract
4	Four	x *	Multiply
5	Five	/	Divide
6	Six	=	Equals/Enter
7	Seven	(	Lt Paren
8	Eight	)	Rt Paren
9	Nine	s	Store
. ,	Decimal Pt	r	Recall
n	Sign	<return>	Save
e	Exponent		

Note that the Graffiti shift indicator is in the view window both on the main and input screens.

Order of Operations

powerOne Graph performs some of its mathematics based on the rules for order of operations. Included is the input screen when in text mode and the solver. The following chart outlines precedence:

Order #	Function
1	Negative (-x) (if Prefs set to –2^2 = 4)
2	Powers and roots
3	Negative (-x) (if Prefs set to –2^2 = -4)
4	Multiplication, division, and percentages
5	Addition and subtraction
6	Bit shift operations (<<, >>)
7	Bitwise operations (&, |, #)
8	Relationship functions (>, <=)
9	Logic or boolean functions (or, and)

Within any priority level, order is established from left to right and function calls or calculations within parentheses are always calculated first.

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The powerOne Graph calculator does not support system find functionality.

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